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31 July 1999
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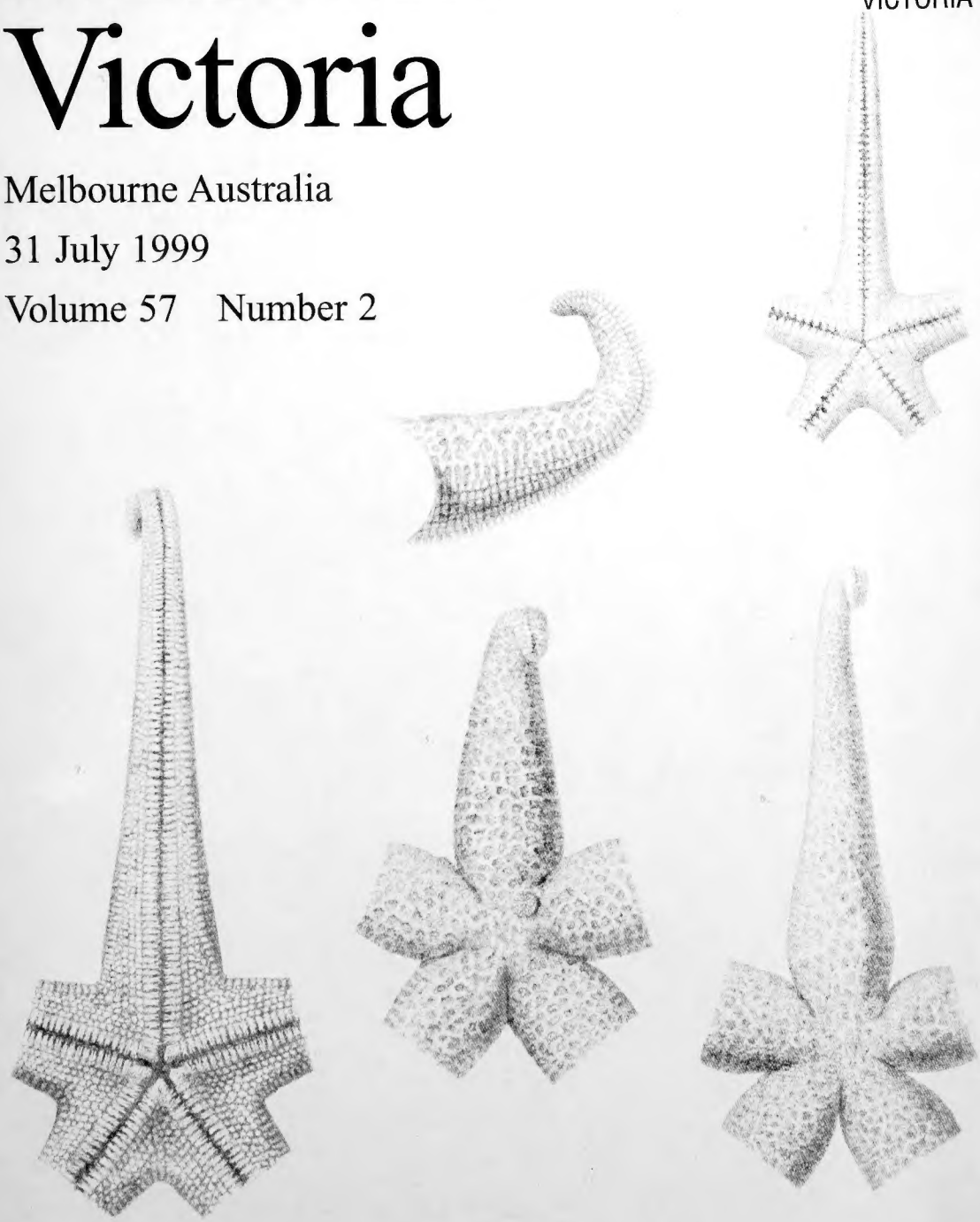

F.H. Michael del.et lith

Mintern Bros. imp.

1–2. CRIBRELLA COMPACTA, n.sp.
3–4. CRIBRELLA OBESA, n.sp.
5–6. CRIBRELLA SUFFLATA, n.sp.
7. CRIBRELLA PRÆSTANS, n.sp.

Front cover: Part of Plate XCVI from W. P. Sladen's (1889) treatment of seastars (Asteroidea) in *Reports of the Scientific Results of the Voyage of HMS "Challenger", 1873–76*. The plate is of four species of *Cribrella* one of which is redescribed as *Henricia obesa* by T. D. O'Hara in this volume of the *Memoirs*. He also describes another similar species in the same family from Macquarie Island.

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Instructions to Authors

Museum Victoria, formerly the Museum of Victoria, was formed in 1983 by the merger of the National Museum of Victoria (established in 1854) and the Science Museum of Victoria (established in 1870). Among the Museum's objectives are scholarship and education in the fields of natural history, science and technology, and history of human society. Museum Victoria publishes two scientific serials to further these objectives, *Memoirs of Museum Victoria* (until 1983 *Memoirs of the National Museum of Victoria*) and *Occasional Papers from Museum Victoria*.

The *Memoirs* publishes papers on original research in the natural sciences pertinent to Victoria and/or the Museum's collections. All contributions are assessed by independant referees before publication.

The *Occasional Papers* are research documents of sufficient importance to be preserved but which are not appropriate for primary scientific publication. Papers are factual rather than interpretative studies, may be of special local interest, or may be longer than a normal scientific paper. Contributions will be refereed if appropriate.

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Papers should be arranged as follows: title (including higher classification of zoological taxa); authors' names and addresses (postal and email); abstract; contents (only if the paper is very long); introduction and main text; acknowledgements; references; index (only if very long); and tables. Captions to text-figures and plates must be attached to the manuscript as final pages. Primary headings are in bold and centred; secondary headings in italics and left-justified. Italics in the text should otherwise be restricted to generic and specific names. Paragraphs are indented with tabs. Measurements must be in the metric system (SI units).

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Paulin, C.D., 1986. A new genus and species of morid fish from shallow coastal waters of southern Australia. *Memoirs of the Museum of Victoria* 47: 201–206.

Last, P.R. and Stevens, J.D., 1994. *Sharks and rays of Australia*. CSIRO: Melbourne. 513 pp.

Wilson, B.R. and Allen, G.R., 1987. Major components and distribution of marine fauna. Pp. 43–68 in: Dyne, G.R. and Watson, D.W. (eds). *Fauna of Australia. General articles. Vol. 1A*. Australian Government Publishing Service: Canberra.

Reference citations use the following style: Paulin, 1986; Last and Stevens, 1994; Smith et al., 1990.

In taxonomic papers synonymies should be of the form: taxon, author, year, pages, figures. A period and dash must separate taxon and author except in the case of reference to the original description, e.g.,

Leontocaris Stebbing, 1905: 98–99.—Barnard, 1950: 699.

Photographs must have clear definition and be submitted as either glossy or matt prints at the actual size for reproduction. Line drawings for text-figures should be in black ink on white card or drawing film. Maximum full-page size is 140 mm wide by 193 mm; single column width is 67 mm. Clear lettering must be inserted. Original line drawings up to three times final size are acceptable.

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Memoirs of Museum Victoria 57(2): 167–223 (1998)

SYSTEMATICS AND BIOLOGY OF MACQUARIE ISLAND ECHINODERMS

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Abstract

O'Hara, T.D., 1999. Systematics and biology of Macquarie Island echinoderms. *Memoirs of Museum Victoria 57*: 167–223.

Fifty-two echinoderm species are recorded from off Macquarie Island and the Macquarie Ridge in the Southern Ocean. One new asteroid *Odontohenricia anarea* sp. nov. and one new holothurian *Trachythyone nelladana* sp. nov. are described. The asteroid genus *Calvasterias* is synonymised with *Anasterias*. The asteroids *Cycethra macquariensis* and *Asterina hamiltoni* are synonymised with *Asterina frigida* and placed in the genus *Cycethra*. The asteroid *Ceramaster lennoxkingi* is synonymised with *C. patagonicus*, *Solaster dianae* with *S. notophrynus*, and *Anasterias sphoerulatus* with *A. mawsoni*. The asteroids *Psilaster charcoti*, *Odontaster penicillatus*, *Ceramaster patagonicus*, *Crossaster multispinus*, *Solaster notophrynus*, *Pteraster affinis*, *Henricia studeri*, the ophiuroid *Ophioplocus incipiens*, and the holothurians *Paelopatides ovalis*, *Synallactes challengeri*, *Laetmogone* sp, *Taeniogyrus* sp are recorded from the island for the first time. The following species previously recorded from Macquarie Island have been re-identified: the asteroids *Odontaster aucklandensis (=O. penicillatus)*, *Henricia aucklandiae (=H. studeri)*, *Henricia lukinsi (=H. obesa)*, *Smilasterias irregularis (=S. clarkailsa)*, *Anasterias antarctica (=A. directa)*, and the ophiuroid *Ophiacantha pentagona (= O. vilis)*. The existence at Macquarie Island of the species *Hymenaster* sp, *Goniocidaris umbraculum* and *Ocnus calcareus* require confirmation. The asteroids *Anasterias mawsoni*, *Pteraster affinis*, *Porania antarctica* and *Odontaster meridionalis* are reported from the shore around Heard Island. The ecology and relationships of echinoderms from Macquarie Island are discussed.

Introduction

Macquarie Island (54°29′S, 158°58′E) is in the Southern Ocean midway between Tasmania and the Victoria Quadrant of the Antarctic continent. The island is small (34 km long and to 5.5 km wide) and, together with small rocky outcrops to the north and south, lies on the central section of the Macquarie Ridge which runs south from New Zealand. This narrow ridge formed of Miocene basalt forms the southeast boundary of the Australian and Pacific tectonic plates, and Macquarie Island is a rare example of uplifted oceanic crust. (Williamson, 1988; Duncan and Varne, 1988; Selkirk et al., 1990). Recent evidence (Adamson et al., 1996) suggests that the ridge at Macquarie Island began its major phase of uplift approximately 5 mya and emerged around 700–600 kya. It has remained emerged for the six glacial/interglacial cycles since that time and experienced only periglacial rather than glacial activity.

The general ecology of Macquarie Island is determined to a great extent by its geographical position. The climate is typical of an isolated midlatitude island, and is characterised by strong winds, frequent storms and high rainfall (Streten, 1988). The water temperature usually varies from 4–7°C. The Antarctic convergence lies only 40 km to the southeast, and cold water can occasionally reach the island causing water temperatures to drop as low as 2.8°C (Williams, 1988). Nevertheless the island is the most southern ice-free shore in the eastern section of the Southern Ocean.

The first echinoderms from Macquarie Island to be reported in the scientific literature were collected by Augustus Hamilton over 2 weeks in March 1894. Hamilton, a biologist with the Otago University in New Zealand, travelled on the ketch *Gratitude* which was supplying a penguin oil industry on the island. He collected "... starfish, echinoderms and holothurians ..." from the eastern shore (Hamilton, 1895). The holothurians were described as a new species, *Psolus macquariensis*, by Dendy (1896) while he was Professor of Biology at the University of New Zealand. Specimens were sent to Europe where they were examined by Ludwig (1898) and Perrier (1905). Ludwig (1898) transferred the species to a new genus *Pseudopsolus*. One six-armed asteroid was identified as *Stichaster*

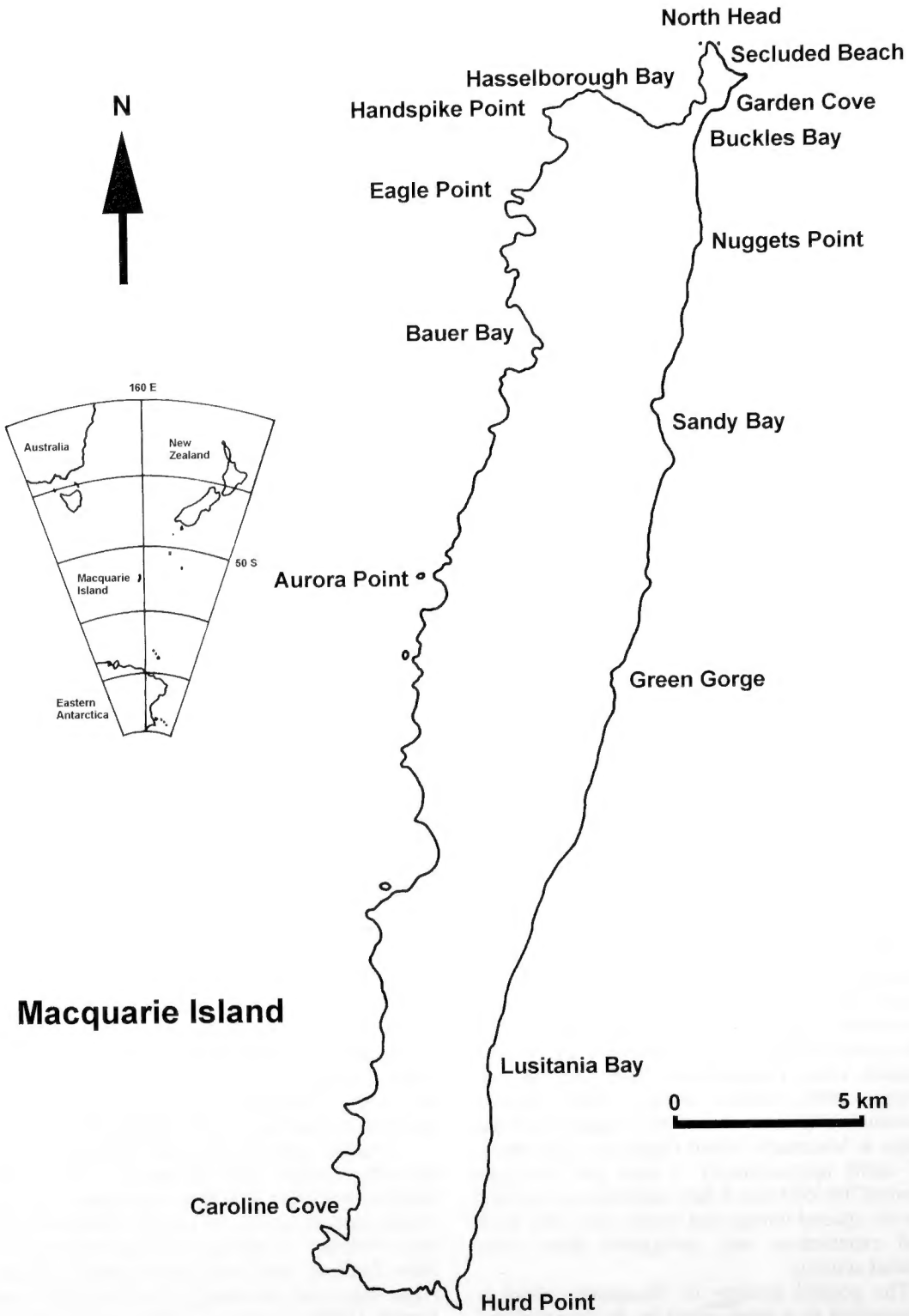

Figure 1. Macquarie Island, showing place names mentioned in the text and the position of the island in the Southern Ocean.

suteri by Benham (1909), but later provisionally referred to *Anasterias mawsoni* by Koehler (1920). Mortensen (1925) recorded a specimen of the New Zealand holothurian *Cucumaria (= Ocnus) brevidentis* var. *carnleyensis* collected by A. Hamilton but suspected that the locality label was incorrect, possibly swapped with the label in an equally aberrant lot of *Pseudopsolus macquariensis* supposedly collected by Benham from Stewart Island, New Zealand.

Harold Hamilton, son of A. Hamilton, spent several years surveying the biology of Macquarie Island as part of the Australasian Antarctic Expedition (AAE) of 1911–1914. Echinoderms were collected from various localities along the coast. From this material, Koehler (1920) described five new species of asteroid: *Parastichaster (=Anasterias) directus, P. mawsoni, P. sphoerulatus, Asterina hamiltoni (=Cycethra frigida) and Cycethra macquariensis (=Cycethra frigida)*, and recorded specimens of *Sporasterias (=Anasterias) antarctica* (herein referred to *Anasterias directa*). Mortensen (1921) and Koehler (1926) recorded specimens of the echinoid *Notechinus (=Pseudechinus) novaezealandiae*. Pawson (1968b) recorded the holothurians: *Pseudopsolus macquariensis, Trachythyone macphersonae, Pseudocnus laevigatus* and an unidentifiable species of *Trochodota* (herein provisionally referred to *Taeniogyrus dunedinensis*). No crinoids (A.H. Clark, 1937) or ophiuroids (Koehler, 1922b) were collected by the AAE expedition from Macquarie Island.

The British, Australian and New Zealand Antarctic Research Expedition (BANZARE) collected from several stations off Macquarie Island during 1–5 December 1930. Echinoderms were collected at station 81, from the shore at Buckles Bay, and dredged from station 83, off Lusitania Bay in 69 m. A.M. Clark (1962) recorded two asteroids from station 81: *Anasterias directa, A. sphoerulata*; three from station 83: *Henricia obesa, Hymenaster* sp., *Smilasterias* sp. cf. *irregularis (=S. clarkailsa)*; and another two previously unrecorded specimens of *Anasterias mawsoni* and *Cycethra macquariensis* collected by the AAE. Madsen (1967) recorded four ophiuroids from station 83: *Ophiacantha pentagona* (herein referred to *O. vilis*), *Amphiura magellanica, Ophiura meridionalis*, and *phiopyren (=Ophioleuce) regulare*. No crinoids (John, 1939), echinoids (Mortensen, 1950) or holothurians (M. O'Loughlin, pers. comm.) appear to have been collected from Macquarie Island.

The Australian National Antarctic Research Expeditions (ANARE) founded a base on Macquarie Island in March 1948. A steady stream of biologists has visited or stayed at the base and systematically or sporadically collected specimens from the shoreline. Most collected predominantly around North Head, from Hasselborough to Buckles Bay. One exception was Wim Vestjens who surveyed many sections of the shoreline during 1961–1962. Reports based on this material have concentrated on the coastal ecology (Law and Burstall, 1956; Kenny and Haysom, 1962; Bennett, 1971; Simpson, 1976), biogeography (Edgar, 1987), reproduction (Simpson, 1982) and pollution (Smith and Simpson, 1995). Pawson (1962) described a new species *Trachythyone macphersonae* from a specimen collected by Hope Macpherson in 1959, and Pawson (1968b), reporting on some specimens collected by Isobel Bennett in 1967, recorded *Pseudocnus laevigatus* from the Island for the first time.

The New Zealand Oceanographic Institute (NZOI) dredged or trawled 47 benthic stations from Macquarie Island and the surrounding ridge between 1959 and 1965. Pawson (1968a) recorded *Psolus antarcticus, Trochodota dunedinensis* and *Pseudechinus novaezealandiae* from off Macquarie Island, and *Pseudocnus leoninoides* and *Goniocidaris umbraculum* from the northern Macquarie Ridge. McKnight (1973b, 1977) described three crinoids from this material, *Ptilocrinus* sp., *Metacrinus wyvillii* and *Comatulides (= Comissia) dawsoni*. McKnight (1984) finally provided an annotated checklist of the echinoderms from the survey. This included five crinoids, 14 asteroids, 11 ophiuroids, two echinoids and two holothurians.

The USS *Eltanin* also trawled several stations off Macquarie, as part of a large Southern Ocean research program. This included stations during cruise 16 (January 1965), cruise 27 (February 1967) and cruise 34 (June 1968). To date only data on the comatulid crinoids have been published; Speel and Dearborn (1983) listed three species from off Macquarie Island. The cidaroid echinoids have been the subject of an unpublished PhD thesis (F.J. Fell, 1976). In addition, some asteroids, echinoids and holothurians have been identified in the Smithsonian Institution (D. Pawson, pers. comm.), a few of which have been examined for this report.

The Australian Museum sponsored a general sublittoral survey of the Island during the summer of 1977–1978 (Lowry et al., 1978). Forty-one SCUBA dives were conducted at six different areas to a depth of 20 m. Several intertidal sites were also surveyed. This material has until now remained unidentified and unpublished. Another survey of the benthic and pelagic fauna was

conducted by ANARE between 6 and 10 December 1986 (Williams, 1988). Fish were the predominant target but many echinoderms were collected in the process. A new species of asteroid, *Smilasterias clarkailsa*, was described from this material (O'Loughlin and O'Hara, 1990). Finally, material was gathered from shallow water (0–3 m) by the author on a short visit to the island in November 1989.

Examination of material from these surveys indicated that the echinoderm fauna of Macquarie Island was imperfectly known. There are now 52 species recorded from Macquarie Island and the surrounding ridge, up from 44 known before this report. Two species are new and 11 species are recorded from the island for the first time. In addition, a revision of published material indicated that there are nine species that have either been erroneously identified or whose presence at Macquarie Island must be placed in doubt. The biogeography of Macquarie Island echinoderms has been discussed by O'Hara (1998a).

The following abbreviations are used. *Morphology*: d.d. - disc diameter (ophiuroids); dia - diameter; l/w - length over width; R - radius from centre of disc to arm tip (asteroids); r - radius from center to margin of disc (asteroids), ht - height; br - breadth (all measurements include skin covering unless stated).

Institutions: Museum Victoria, Melbourne (NMV); Australian Museum, Sydney (AM); South Australian Museum, Adelaide (SAM); Tasmanian Museum and Art Gallery, Hobart (TM); National Institute of Water and Atmospheric Research (formerly New Zealand Oceanographic Institute), Wellington (NIWA); the Natural History Museum, London (BMNH); National Museum of Natural History, Smithsonian Institution, Washington (USNM); Zoologisk Museum, University of Copenhagen (ZMUC).

Material examined. The bulk of material examined for this report was collected from Macquarie Island by the 1986 ANARE Macquarie Island biological trawl program (lodged in the NMV), the 1977–1978 Australian Museum Macquarie Island Expedition (AM) and various shore collections (NMV, AM, TM). The stations and material from the 1986 ANARE cruise is listed in Table 1. The station list (MA stations) for the 1977–1978 AM expedition (Lowry et al., 1978) is too large to reproduce here and the material has been included in Table 2. Historical material examined includes specimens from the AAE (AM, BMNH), BANZARE (SAM, BMNH), NZOI (NIWA) and *Eltanin* (USNM) expeditions. This material was compared with numerous species from surrounding regions including Australia (AM, NMV), New Zealand (ZMUC, AM), Kerguelen (BMNH), Marion Island (AM), Heard Island (BMNH, NMV), South America (BMNH, ZMUC) and Antarctica (BMNH, AM, SAM, NMV). Comparative material is listed separately under each species below.

Phylum Echinodermata

Class Crinoidea

Key to Macquarie Island Crinoidea

1. Stem present 2
— Stem absent 3
2. Stem without cirri, stem terminates in a basal disk ..... *Ptilocrinus* sp.[a]
— Stem bearing cirri at regular intervals ..... *Metacrinus wyvillii*[b]
3. Usually more than ten arms 4
Ten arms only 5
4. Oral pinnules flexible, usually with more than 30 segments. Arms rounded or square with smooth sides at the arm base, 11–20 arms. Cirri stout, with fewer than 25 segments ..... *Glyptometra inaequalis*[c]
— Oral pinnule prismatic, oral pinnules with less than 15 segments. Arms laterally compressed, with spinous median keel near the base of the arm, 10–13 arms. Cirri long and slender, with more than 25 segments ..... *Daidalometra arachnoides*[d]
5. Auxiliaries and second brachials with prominent proximal lobes, which incise the neighbouring ossicles ..... *Florometra austini*
— Auxiliaries and second brachials proximally truncate 6
6. Oral pinnules with short segments, as long as wide, toothed distal segments forming a rudimentary comb ..... *Comissia dawsoni*[e]
— Oral pinnules with long and slender segments, to three times as long as wide ..... *Antedonid* sp.[f]

Notes on key:

[a] McKnight (1973b: 204; 1984: 141) recorded ossicles of a stalked crinoid, possibly of the genus *Ptilocrinus*, from the southern Macquarie Ridge (NZOI stn D5, 56°40.6′S, 158°45.5′E, 1280 m). McKnight noted that it was probably related to *P. antarcticus* Bather, a deep-water Southern Ocean species.

[b] McKnight (1973b: 202; 1984: 141) recorded a single fragmented specimen of *M. wyvillii* Carpenter, 1884 from the Northern Macquarie Ridge (NZOI stn D159, 49°01′S, 164°30′E, 741 m). This species otherwise been found in deep-water Pacific localities.

[c] McKnight (1984: 141) and Speel and Dearborn (1983: 24–25) recorded *G. inaequalis* (Carpenter, 1888) from off Macquarie Island and off the northern Macquarie Ridge (682–1693 m). This species otherwise occurs throughout the Southern and South Pacific Oceans.

[d] Speel and Dearborn (1983: 22–24) recorded a single specimen of *D. arachnoides* (A.H. Clark, 1909) to the northeast of Macquarie Island in 1647–1665 m. This species has been otherwise recorded from the tropical western Pacific Ocean (22–118 m) and near Auckland Island south of New Zealand (952–1336 m).

[e] McKnight (1977: 99–100, fig. 7–9; 1984: 141) recorded 15 specimens of *C. dawsoni* (McKnight, 1977) from the northern Macquarie Ridge (NZOI stn D18, 52°31′S, 160°31′E, 128 m). This species was originally described as *Comatulides dawsoni* but transferred to *Comissia* by Hoggett and Rowe (1986: 121). This comasterid is unusual in having a central mouth and 10 arms. It has otherwise been found from three localities on the Campbell Plateau, south of New Zealand (128–1280 m).

[f] Speel and Dearborn (1983: 52) recorded four specimens of "Unidentified Antedonid species B" from two *Eltanin* stations off Macquarie and Auckland Islands (750–996 m). They note that A.M. Clark, who examined the specimens, was uncertain of their affinities within the family Antedonidae.

Table 1. Echinoderms from ANARE Macquarie Island benthic trawl stations, December 1986

BT1, off Lusitania Bay, 54°44.0′S, 158°51.4′E, 3541 m, 6 Dec 1986
No echinoderms.

BT2, off Lusitania Bay, 54°43.5′S, 158°53.1′E, 100–105 m, 6 Dec 1986
Odontaster penicillatus, Porania antarctica, Henricia studeri, Henricia obesa, Smilasterias clarkailsa, Amphiura magellanica, Pseudechinus novaezealandiae, Psolus neozelanicus, Pseudocnus laevigatus, Trachythyone macphersonae

BT3, off Nuggets Point, 54°33.4′S, 158°56.9′E, 108–135 m, 8 Dec 1986
Florometra austini, Odontaster penicillatus, Ceramaster patagonicus, Henricia studeri, Henricia obesa, Smilasterias clarkailsa, Ophiacantha vilis, Amphiura magellanica, Ophiura meridionalis, Pseudechinus novaezealandiae, Psolus neozelanicus, Trachythyone nelladana sp. nov., *Pseudocnus laevigatus, Trachythyone macphersonae*

BT4, off Lusitania Bay, 54°45.0′S, 158°52.3′E, 65–90 m, 9 Dec 1986
Odontaster penicillatus, Porania antarctica, Henricia studeri, Henricia obesa, Amphiura magellanica, Ophioleuce regulare, Pseudechinus novaezealandiae, Pseudocnus laevigatus, Trachythyone macphersonae, Taeniogyrus dunedinensis

BT5, off Lusitania Bay, 54°44.2′S, 158°52.3′E, 57–70 m, 9 Dec 1986
Henricia studeri, Henricia obesa, Amphiura magellanica, Pseudocnus laevigatus

BT6, off Lusitania Bay, 54°43.4′S, 158°52.1′E, 25–29 m, 9 Dec 1986
Psilaster charcoti, Ophioplocus incipiens, Pseudechinus novaezealandiae

BT7, off Eagle Point, 54°31.4′S, 158°50.8′E, 150–200 m, 10 Dec 1986
Amphiura magellanica

BT8, off Handspike Point, 54°29.7′S 158°51.2′E, 330–450 m, 10 Dec 1986
Henricia studeri, Solaster notophrynus., Crossaster multispinus, Amphiura magellanica, Ophiura (Ophiuroglypha) irrorata

BT10, off Judge and Clerk Rocks, 54°23.6′S, 158°59.3′E, 100 m, 10 Dec 1986
Odontaster penicillatus., Henricia studeri, Henricia obesa, Odontohenricia anarea sp. nov., *Ophiacantha vilis, Pseudechinus novaezealandiae*

Table 2. Distribution of shallow water echinoderms around Macquarie Island (0–20 m)

	Anasterias directa	*Anasterias mawsoni*	*Cycethra frigida*	*Pseudechinus novaezealandiae*	*Ophiacantha vilis*	*Pseudopsolus macquariensis*	*Trachythyone macphersonae*	*Pseudocnus laevigatus*	
North Head	x	x							
Gorilla Head Rock	x	x	x	x				x	
Tottan Head, Goat Bay	x	x	x	x	x		x	x	
Secluded Beach	x	x	x			x			
Tern Rock Bay	x	x		x		x	x	x	
Garden Cove and Hayter Rock	x	x	x	x	x	x	x	x	*Smilasterias clarkailsa* *Taeniogyrus dunedinensis*
Buckles Bay	x	x		x	x	x	x	x	*Amphiura magellanica*
Nuggets Point	x	x					x		
Sandy Bay	x	x		x			x	x	*Henricia obesa*
Green Gorge	x	x	x	x		x	x	x	*Taeniogyrus* sp.
Lusitania Bay	x	x							
Hurd Point	x								
Caroline Cove	x	x	x	x	x		x	x	*Porania antarctica* *Henricia obesa* *Pteraster affinis* *Smilasterias clarkailsa*
Aurora Point	x								
Bauer Bay	x					x			
Handspike Point	x		x				x	x	
Hasselborough Bay	x	x				x			
Aerial Cove	x	x	x	x	x	x	x	x	
Anchor Rock	x	x	x				x	x	

Order Comatulida

Antedonidae

Florometra austini A.M. Clark

Plate 3k

Florometra sp.—A.M. Clark, 1966: 704.
Florometra austini A.M. Clark in A.H. Clark and A.M. Clark, 1967: 324, fig. 16.—Speel and Dearborn, 1983: 29, fig. 3, tbl. 6.—McKnight, 1984: 141.

Material examined. ANARE 1986 Expedition, BT3, NMV F60300(1).

Description of material. Centrodorsal hemispherical, 1.8 mm dia, 1.0 mm high; approximately 70 cirri (mostly broken), cirrus sockets in alternating rows, remaining cirri with 13–16 segments, proximal 2 segments wider than long, middle segments 2.5 times longer than wide, slightly waisted, distal rim slightly everted, distal segments just longer than wide, terminal claw and opposing spine well developed. 10 arms, all broken; 5 radials, $1Br_1$ very short, auxiliaries cruciform, proximal lobe (synarthial tubercle) overlying $1Br_1$, second brachial also with proximal synarthial tubercle that overlies Br_1, succeeding brachials wedge shaped, with slightly everted distal edges. First syzygy at 3+4, second at 9+10, length between $1Br_1$ to second syzygy 4 mm. P_1 and P_a very long, to 6 mm, approx 25 segments, proximal segments longer than wide, distal segments small, as long as wide, with low dorsal tubercles, pinnule appearing comb-like. P_2, the first genital pinnule, with 12 segments, 2 proximal segments small, as long as wide, next 7 segments enlarged and widened, 2–3 times as long as wide, bearing the gonad, distal segments slender, with spinous distal edges. Similar genital pinnules present until P_7. Disc naked, mouth central, anal cone eccentric, high and slender.

Colour. Macquarie specimen (in alcohol) with white arms and centrodorsal, brown disc and gonads.

Habitat. A.M. Clark (1966) records this species from a bryozoa/sponge substrate.

Distribution. Cook Strait, New Zealand (192–550 m); off Campbell and Antipodes Islands (58–210 m); Macquarie Island and the Macquarie Ridge (108–135 m).

Remarks. The cirri and pinnules P_1 and P_a on this specimen have far fewer segments than was reported for the type series. Possibly this can be attributed to the larger size of the types (centrodorsal = 4.0–5.5 mm dia). In this species P_2 is usually similar to P_1, long and flagellate with many segments. P_3 is usually the first genital pinnule, however, P_2 or P_4 can occasionally be the first to bear a gonad. This species was previously known from Macquarie Island only from fragments.

Class Asteroidea

Key to Macquarie Island Asteroidea

(modified from A.M. Clark, 1962)

1.	2 series of tube feet in each arm furrow. Pedicellariae rare (except *Ceramaster*)	2
—	4 series of tube feet in each arm furrow. Straight and crossed pedicellariae common	15
2.	Marginal arm plates large and conspicuous, forming a continuous rim around the disc and arms	3
—	Marginal arm plates small, usually inconspicuous, often similar to abactinal plates	6
3.	Tube feet pointed, lacking suckers	*Psilaster charcoti*
—	Tube feet with sucking disks	4
4.	Stellate form, arms long and pointed	*Pseudarchaster* sp.[a]
—	Subpentagonal form	5
5.	Large conspicuous recurved oral spine at the apex of each jaw	*Odonaster pencillatus*
—	Several blunt tipped oral spines around the jaw margin. Pedicellariae present with large flat valves	*Ceramaster patagonicus*
6.	Disc covered in a thick skin and low sparse tubules. 5 short arms. Ventral disc surface without spines, covered in radial striations	*Porania antarctica*
—	Not as above	7

7. Abactinal plates with a median pillar (pedicel) which bears crown of spinelets (paxillae) 8
— Abactinal plates flat or slightly convex, bearing spines or granules. No paxillae 12
8. Abactinal surface roofed over by a membrane supported by elongate paxillar spines forming a chamber. 5 arms, with a conspicuous webbed actinolateral fringe of spines 9
— Abactinal paxillae free of a membrane covered chamber. 7–11 arms 11
9. Adambulacral spines not webbed ..... *Hymenaster* sp.[b]
— Adambulacral spines webbed 10
10. Oral spines not webbed ..... *Pteraster stellifer*[b]
— Oral spines webbed ..... *Pteraster affinis*
11. Abactinal paxillae with short spines and arranged in regular oblique rows. 7 arms ..... *Solaster notophrynus*
— Abactinal paxillae with long penicillate spines and arranged in an irregular reticulum. 9–11 arms ..... *Crossaster multispinus*
12. Subpentagonal form. 5 short triangular arms. Dorsal side convex, ventral side flat ..... *Cycethra frigida*
— Disk small, 5 long slender subcylindrical arms. 1–2 sabre-shaped adambulacral spines deep in arm furrow 13
13. Large recurved oral spine at each jaw tip ..... *Odontohenricia anarea* sp. nov
— Several small oral spines around the jaw margin 14
14. Abactinal spinelets small and numerous, up to 30 per plate ..... *Henricia studeri*
— Abactinal spinelets stout and spaced, up to 6 per plate ..... *Henricia obesa*
15. 2 or more spines on each adambulacral plate 16
— 1 spine on each adambulacral plate 17
16. 1 longitudinal dorsolateral series of spines ..... *Sclerasterias mollis*[c]
— Numerous dorsolateral spinelets ..... *Smilasterias clarkailsa*
17. 5 arms ..... *Anasterias directa*
— 6 arms ..... *Anasterias mawsoni*

Notes on key:

[a] McKnight (1984: 141) recorded a juvenile specimen of a *Pseudarchaster* species from off Macquarie Island (NZOI stn C734, 53°55′S, 158°55′E, 360 m). McKnight noted its close similarity to *P. abernethyi* H.B. Fell, 1958 from New Zealand. Another species *P. discus* Sladen, 1889 occurs off South America and Marion Island.

[b] A.M. Clark (1962: 67) recorded a juvenile *Hymenaster* specimen from BANZARE station 69 off Lusitania Bay, and McKnight (1984: 143) recorded a specimen of *Pteraster stellifer* Sladen, 1889 from Macquarie Island (NZOI stn C734, 53°55′S, 158°55′E, 360 m). Both these specimens are discussed under *Pteraster affinis*.

[c] McKnight (1984: 143) recorded two specimens of *S. mollis* (Hutton, 1872) from the northern Macquarie Ridge (NZOI stn D20, 49°39.8′S, 164°02.2′E, 126 m). *S mollis* is otherwise known from the South Island of New Zealand and the Chatham Islands, 22–697 m.

Order Paxillosida

Astropectinidae

Psilaster charcoti (Koehler)

Plate 1a

Ripaster charcoti Koehler, 1906: 4–6, pl. III figs 20, 21, 31, 32.—Koehler, 1920: 258–259, pl. LI fig. 5, pl. LII fig. 1, pl. LXXII fig. 1.

Psilaster charcoti.—Fisher, 1940: 93–94.—A.M. Clark, 1962: 13.—H.E.S. Clark, 1963: 30–31, text-fig. 4, pl. 3 figs 7–8. —A.M. Clark, 1989: 290.

Material examined. Macquarie Island, ANARE 1986 Expedition, BT6, NMV F60274(1); Antarctica, 65° 42′S, 92° 10′E, 110 m, 21 Jan 1914, AAE stn.7, identified by Koehler (1920), AM(1); MacRobertson Land, 66° 45′S, 62° 03′E, 219 m, BANZARE stn 107, K1400(2).

Comparative material examined. Psilaster acuminatus Sladen, 1889: Australia, eastern Bass Strait, 38° 23′S, 148° 46′E, 448–460 m, 5 May 1984, NMV F82984(1).

Description of Macquarie Island material. R = 50 mm, r = 11 mm; 5 arms, flattened, tapered evenly to narrow point, 2 arms bent back over disc. Disc

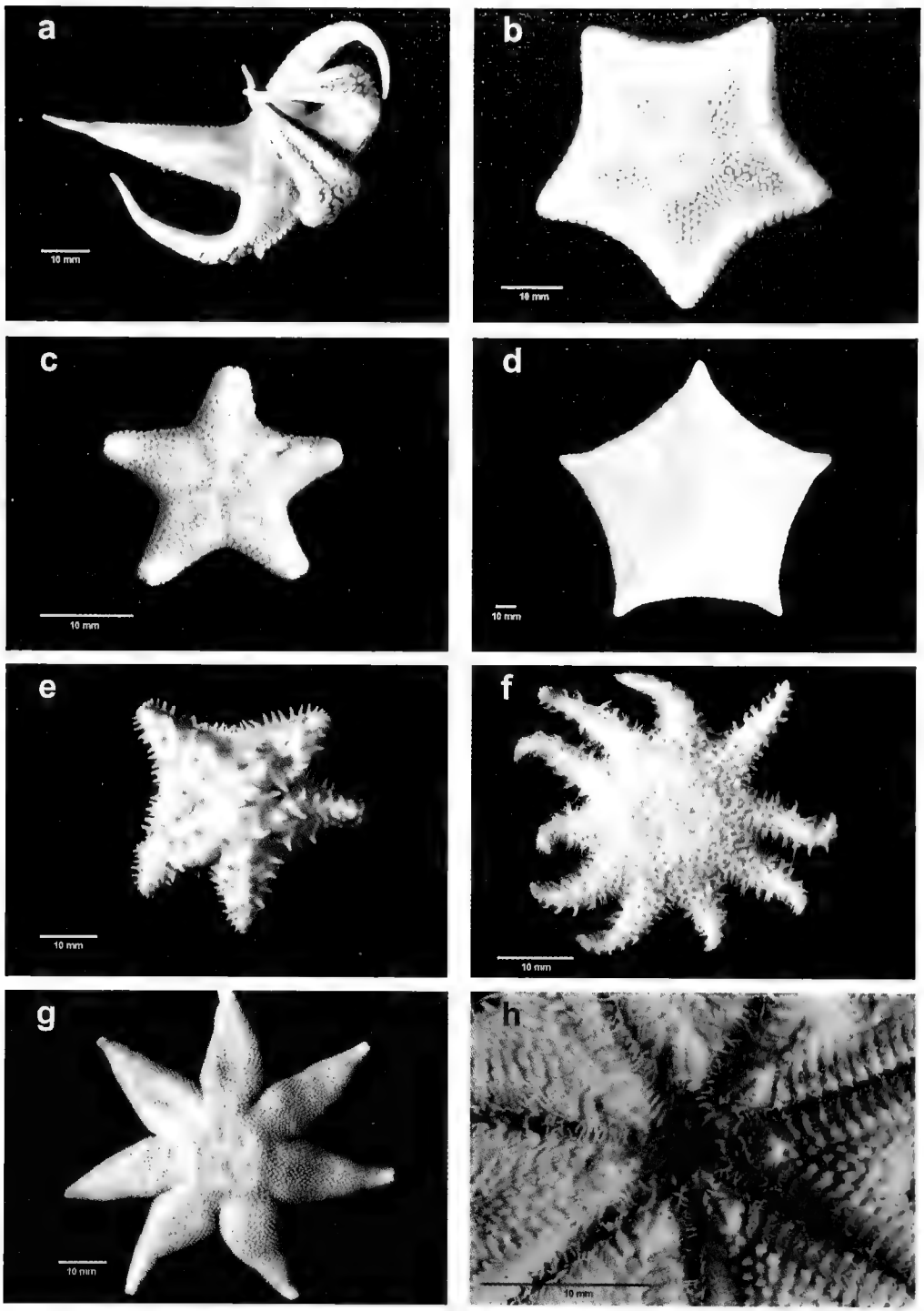

Plate 1. a, *Psilaster charcoti*, dorsal view (lower arm slightly damaged on margin), NMV F60724; b, *Odontaster penicillatus*, dorsal view, NMV F60276; c, *Cycethra frigida*, dorsal view (disc slightly damaged on upper right), NMV F76227; d, *Ceramaster patagonicus*, dorsal view, NMV F76237; e, *Porania antarctica*, dorsal view, NMV F60278; f, *Crossaster multispinus*, dorsal view, NMV F60291; g, *Solaster notophrynus*, dorsal view (skin removed from arm on left), NMV F60290; h, *Solaster notophrynus*, oral view, NMV F60290.

with central epiproctal cone and exposed madreporite. Abactinal plates in close uniform reticulum, lobed, with narrow bars connecting up to 6 neighbouring plates. Plates paxillate with high narrow pedicel, widened at tip, bearing 4–9 short spinelets. Papular areas small, each with 1 papula. Marginals prominent, lateral in position, up to 50 along arm, protrudent with fascioles between plates, superomarginals slightly smaller than inferomarginals, plates covered by numerous small thin spinelets, some capitate, some serrate, with transverse row of large flattened pointed spines in centre of plate, up to 4 on superomarginals extending to next plate, up to 4 larger spines on inferomarginals, extending in length over 2 plates, to 3.0 mm long. Up to 5 series of actinals on interradial area of disc, only 1 persists beyond fifth marginal plate, to at least three-quarters R, plates small, convex, more numerous than adambulacrals, paxillate with 3–10 small conical subequal spinelets, often convergent. Adambulacrals with 3–4 long angular pointed furrow spines, central spine longest, to 2.0 mm, up to 6 clustered subambulacral spines, proximal pair of plates laterally compressed with no furrow spines. Oral plates elongated, tumid, projecting into mouth, with 2 rows of spines on either side of the plate, furrow row with 10–12 thick blunt spines, innermost 1–2 enlarged, up to 6 suboral spines. Furrow narrow, 2 series of pointed tube feet without suckers. Ventral surface covered in gelatinous material that obscures spines.

Reproduction. This species develops lecithotrophic swimming non-feeding larvae; egg size varies from 0.77 mm (Arthur Harbour, Scotia Arc) to 0.95 mm dia (McMurdo Sound) (Pearse and Bosch, 1994).

Colour. Macquarie Island specimens (in alcohol) light tan. Falkland Island specimens coloured pink dorsally, sometimes purple in the disc centre and yellow ventrally (Fisher, 1940). Antarctic specimens reddish brown or brown yellow (Koehler, 1912).

Habitat. Usually mud, sometimes with pebbles, rock (Fisher, 1940) or sponge/bryozoa (H.E.S. Clark, 1963).

Distribution. Circumpolar Antarctic, South Georgia, Bouvet Island (30–3248 m); Macquarie Island (25–29 m).

Remarks. The Macquarie specimen closely matches the descriptions and figures of Koehler (1906, 1920) and H.E.S Clark (1963). I have compared it to Antarctic specimens identified by Koehler (1920) and A.M. Clark (1962). These are similar although larger specimens (R > 90 mm) differ in having more numerous spines, 8–12 abactinal spinelets, 5 superomarginal spines, 5 inferomarginal spines, and subequal oral spines. H.E.S. Clark (1963) recorded paxillate pedicellariae on her Ross Sea specimens. These are absent from the current specimens.

A similar species, *P. acuminatus* Sladen, 1889, is known from off Australia, New Zealand and South Africa. An Australian specimen in Museum Victoria was examined for comparison. It differs in having larger marginal plates, fewer spines on the inferomarginals, rare or absent superomarginal spines, and larger abactinal paxillae. *Proserpinaster neozelanicus* (Mortensen, 1925), another superficially similar species from New Zealand, differs in having larger marginal plates which extend onto the dorsal surface, 2 rows of larger spines on inferomarginal plates and 2 series of actinal plates persisting along the arm length. *Bathybiaster loripes* Sladen, 1889, a wide ranging Southern Ocean astropectinid, has smaller enlarged spines on the marginal plates and a mixture of large and small spinelets on the abactinal paxillae.

P. charcoti is a new record for Macquarie Island. It is has previously been recorded only in Antarctic waters.

Order Valvatida

Odontasteridae

Odontaster penicillatus (Philippi)

Plate 1b

Goniodiscus penicillatus Philippi, 1870: 268.

Odontaster penicillatus.—Fisher, 1940: 105–109.—A.M. Clark and Downey, 1992: 156–157, figs 24i–j, 26n–p, pl. 37b [full synonymy],—A.M. Clark, 1993: 197.

Odontaster aucklandensis.—McKnight, 1984: 141 [non *O. aucklandensis* McKnight, 1973c].

Material examined. Macquarie Island, off Buckles Bay, 372 m, Feb 1967, NMV F60275(1). ANARE 1986 Expedition, BT2, NMV F60277(1); BT3, NMV F60276(2); BT4, NMV F76225(2); BT10, NMV F60313(1).

Falkland Islands, *Discovery* stns WS73, WS93, WS824, WS848, 115–130 m, identified by Fisher (1940), BMNH 1948.3.16.237,264,274,277.

Argentina, Buenos Aires, 38°25′S, 56°30′W, identified Bernasconi, BMNH, 1960.9.1.1(1).

Comparative specimens examined. *O. meridionalis* (Smith, 1876): Heard Island, Camp Beach, washed up after storm, NMV F76234(8); Counthian Beach, 7 Jun 1951, NMV F76235(4); S.W Beach, 1 Aug 1951, NMV

F76236(6); *O. penicillatus grayi* (Bell, 1881): Punta Arenas, Sandy Point, HMS *Alert*, 17–19 m, BMNH (holotype). *Odontaster benhami* Mortensen, 1925: New Zealand, Oamaru, 37–55 m, 1960, AM J7067(4).

Description of Macquarie Island material. R = 16 to 50 mm, r to 28 mm. Disc flat, subpentagonal with slightly concave margins. Abactinal disc plates tabulate, with 4–18 spinelets, peripheral spinelets slightly more pronounced. Spinelets on largest specimen granule-like, truncate, as wide as high, some with angular edges; spinelets on smaller specimens terminating in small glassy thorns. Up to 25 plates between margin and disc centre. Papulae present between tabulae on disc and radial areas. Large tumid marginal plates fringe body margin, 35 plates from arm tip to arm tip on largest specimen, 18–19 when R = 23 mm, with up to 300 spinelets per plate, similar in form to abactinal spinelets, slightly longer on inferomarginal plates. Actinal plates convex, to 10 rows, with 5–12 spinelets; spinelets near mouth long, bluntly pointed, 3–4 times as high as wide, up to 1.1 mm high, orientated distally; marginal spinelets shorter, more granular and less numerous. No actinal papulae. Adambulacral plates with 6–12 spines in 2 transverse rows, 2–3 spines nearest furrow longest, up to 1.6 mm, cylindrical or slightly flattened, blunt tips, spines decreasing in length away from furrow. 1 (rarely 2) large recurved oral spines at the jaw tip, orientated distally, with pointed glassy tip, on largest specimen 4 mm long, with slightly keeled ventral midline, up to 2 mm long when R = 23 mm. 2 series of suckered tube feet. No pedicellariae.

Colour. Macquarie Island specimens (in alcohol) light tan. Live Atlantic specimens greyish, orange, yellow or brown (A.M. Clark and Downey, 1992).

Habitat. Sand, coarse shell and pebbles, mud (A.M. Clark and Downey, 1992); rock (Branch et al., 1993).

Distribution. Southern South America, Falkland Islands, Burwood Bank (8–350 m); Marion Island (527 m); Macquarie Island (55–372 m).

Remarks. As noted in the description, the largest Macquarie Island specimen differs from the smaller specimens in the form of the abactinal spinelets. There is a similar range of variation in the abactinal spinelets on specimens of *O. penicillatus* I have examined from South America. The number of spinelets can reach 50 per paxillae (BMNH, 1948.3.16.277) and the shape can vary from squat, capitate with a thorny apex to long, tapering and serrated. Specimens of *O. meridionalis* (Smith, 1876) from Heard Island also vary in the form of the abactinal spinelets, with only some having glassy tips. Conversely, the presence of pointed glassy tips on the abactinal spinelets has been used to distinguish the New Zealand species *O. benhami* Mortensen, 1925 from the subantarctic New Zealand species *O. aucklandensis* McKnight, 1973c.

The Macquarie specimens are provisionally referred to the polymorphic species *O. penicillatus*. This species varies from stellate in form with numerous small marginal plates to subpentagonal with fewer larger marginal plates (Fisher, 1940; A.M. Clark and Downey, 1992). Subpentagonal forms from the Magellanic region have been named *O. penicillatus grayi* (Bell, 1881). This subspecies differs from the Macquarie specimens in possessing pedicellariae (Mortensen, 1925). McKnight (1984) referred his Macquarie Island material to *O. aucklandensis* but the present specimens (from Macquarie Island and South America) lack the distinctive glassy granules that occur on the abactinal tabulae of the New Zealand species *O. aucklandensis* and *O. benhami*.

Ganeriidae

Cycethra frigida (Koehler) comb. nov.

Plate 1c, Figure 2

Asterina frigida Koehler, 1917: 46–48, pl. 6 figs 9–11, pl. 7 fig. 8.—Madsen, 1955: 13.—A.M. Clark, 1962: 33.—Guille, 1974: 34.—Cherbonnier and Guille, 1975: 615.—A.M. Clark, 1993: 209.

Asterina hamiltoni Koehler, 1920: 133–136, pl. 35 figs 5–7, 10, pl. 36 figs 1–3, pl. 66 fig. 5.—A.M. Clark, 1962: 24.—Bennett, 1971, pl. 56 fig. 4.—Rowe and Pawson, 1977: 343.—A.M. Clark, 1993: 210. O'Hara, 1998a: 146. [new synonymy]

Cycethra macquariensis Koehler, 1920: 139–142, pl. 34 figs 1–4, 6, 7, pl. 66 figs 5a, b.—A.M. Clark, 1962: 24–25.—Rowe and Pawson, 1977: 345.—Simpson, 1982: 45.—McKnight, 1984: 142.—A.M. Clark, 1993: 200. [new synonymy]

Material examined. Macquarie Island, no date, AM J3520(holotype of *A. hamiltoni*); 10 Oct 1913, AM J3605(holotype of *C. macquariensis*); AAE expedition, BMNH, 1965.8.5.27(1); Secluded Beach, 27 Nov 1989, NMV F76232(2); NMV F76233(3); Garden Cove, 21 Aug 1952, NMV F75925(1); 31 Mar, 1962, NMV F45113(3); 12 Aug 1962, NMV F45112(1); no date, NMV F45008(1); 25 Nov 1989, 0.5–1m, NMV F76229(1); NMV F76230(2); NMV F76231(3); 26 Nov 1989, NMV F76227(5); Aerial Cove, 26 Jan 1950, NMV F75924(1); 28 Nov 1989, NMV F76228(3). AM 1977–1978 Expedition, Gorilla Head Rock (9–12 m), MA-142(2), MA-145(1), MA-149(3); Tottan Head, Goat Bay (9–14 m), MA-39(1), MA-41(2), MA-42(1), MA-371(5), MA-374(8), MA-376(3); Garden Cove (6–14 m), MA-87(1), MA-92(1), MA-124(3),

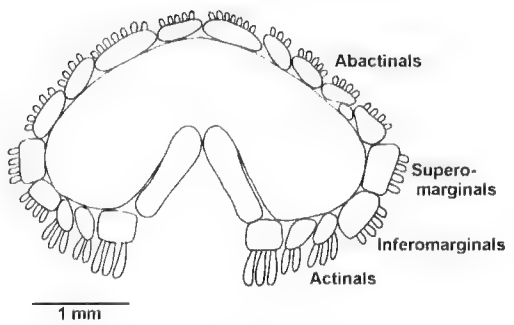

Figure 2. *Cycethra frigida*, NMV F76231, schematic diagram of an arm cross section showing the position of the skeletal plates and the absence of internal struts.

MA-125(2), MA-127(3), MA-128(3), MA-350(1), MA-379(8); Green Gorge (14–18 m), MA-245(4), MA-251(2); Caroline Cove (8–13 m), MA-300(1), MA-306(3); Handspike Point (intertidal), MA-136(4); Aerial Cove (3–6 m), MA-47(3), MA-85(3), MA-98(1), MA-100(1), MA-107(13), MA-108(8), MA-109(7), MA-110(2), MA-382(8), MA-386(6), MA-387(1), MA-388(4), MA-389(2); Anchor Rock (20 m), MA-89(2).

Kerguelen, NW end of Long Island, BANZARE stn 56A, identified by A.M. Clark (1962), BMNH, 1965.8.5.48(2); Jeanne d'Arc, 20 m, BANZARE stn 5, SAM K1420(1); BANZARE collection 784, littoral, SAM K1421(3); Gazelle Basin, 25 28 Dec 1898, *Valdivia* stn 160, identified by Madsen (1955), ZMUC(1).

Description of Macquarie Island material. R to 20 mm, r to 9 mm, disc higher than arms, ventral, dorsal surfaces mostly flat, often small sunken areas on dorsal interradius; 5 arms (1 specimen with 4 arms, NMV F76233), short but distinct, dorsally convex, ventrally flattened , wide at base, tapering blunt, rounded tip. Madreporite halfway to interradial margin; anus sometimes visible centrally; 2 gonopores sometimes visible on mid-actinal area. Abactinal plates cruciform, stellar, triangular or irregularly-shaped, with low convex 'Y'-shaped or broadly-cresentic thickened region bearing spinelets, rest of plate flat, thin, imbricating with 3–5 neighbouring plates; some small round secondary plates in papular areas. Plates irregularly arranged. Papular areas small, no larger than plate with 1, rarely 2, papulae. Abactinal spinelets in round or oval cluster, 4–36, usually 10–20 per plate. Spinelets short, blunt, terminally spiniferous, l/w = 2–2.5 (up to 3 when cleaned of skin, with constricted waist in middle). Spinelet clusters obscuring underlying network of plates.

Superomarginal plates larger than abactinals, lateral or ventral position on disc, lateral on arms, convex, 35 plates from arm tip to arm tip on R = 17 mm, proximal plates oval, 2–2.5 times as high as wide, orientated transversely, plates placed obliquely near arm base and on arm, plates on arm 1–1.5 times as high as wide. Inferomarginals oval, convex, 1–1.5 times as high as wide, slightly oblique on arms. Marginal spinelets as abactinals, 2 transverse rows on proximal plates with up to 7 spinelets in each row, 3 rows or cluster on distal plates. Actinals block-like, rectangular, in an imbricating lattice, up to 10 plates from margin to jaw; distal plates shorter; forming longitudinal rows near the furrow, distal plates irregular or in irregular transverse rows; 2 of the longitudinal rows persist onto the arms, one to tip. No actinal papulae. Actinal spinelets longer than abactinals, 1–5, usually 2–3 per plate, cylindrical, thickened, blunt tip or tapered, 2–3 times as high as wide (4 times as high as wide when skin covering bases is removed), up to 0.4 mm high.

Adambulacral plates rectangular, sometimes constricted in middle, well separated from each other. Adambulacral spines longer than actinals, to 0.8 mm long, club-shaped, 4 times as high as wide; 3–4, per plate, positioned irregularly on plate, only sometimes in transverse row, usually only 1 on furrow margin; subequal or furrow spine larger. Furrow spinelets near jaw sometimes enlarged. No superambulacral plates, no internal extensions of abactinal or actinal plates; proximal interradial calcified pillar supports abactinal body wall. 3 oral spines on oral margin of plate, larger than adambulacral spines, 1–3 suboral spines. 2 series of suckered tube feet.

Reproduction. Separate sexes, egg size in gonad variable, to 0.8 mm dia, appears to breed throughout the year; possibly lays egg cases (Simpson, 1982).

Colour. Macquarie Island specimens (live) usually pale olive green on the dorsal surface (including superomarginals), sometimes light grey, purple or brown, arm tips paler; ventral surface (including inferomarginals) light tan, very light orange or cream; tube feet darker tan or orange; preserved material is tan with darker tube feet. Kerguelen specimens are light brown (Cherbonnier and Guille, 1975).

Habitat. In the immediate sublittoral (0.5–2 m) it is found on rock boulders or gutters underneath the kelp (*Durvillaea*) zone. In the sublittoral (to 20 m) found mostly on rocky substrates in association with sponges, hydroids and red algae, or amongst *Macrocystis* beds. McKnight (1984) has reported a dredged specimen from 95 m.

Distribution. Kerguelen (0–20 m), Macquarie Island (0–95 m).

Remarks. Examination of a range of specimens indicates that *Cycethra macquariensis* and *Asterina hamiltoni* are synonyms of *Asterina frigida*. Koehler (1920) did not compare his three species. Both Macquarie Island species were based on single specimens. The main differences in the descriptions are the relative size (smaller in *C. frigida*), density of the abactinal skeleton, the length of the abactinal spinelets and the number of actinal spinelets per plate (A.M. Clark, 1962). However, the minor variations in the numbers of actinal spinelets, abactinal spinelets and papulae, the density of the skeleton, and the colour do not form any recognisable pattern in the current range of specimens. Moreover, the skeleton is flexible and consequently preserved specimens can look superficially different depending on whether the arms are flexed slightly downward (dorsal skeleton appearing open, actinal spinelets spread out) or upward (dorsal skeleton appearing robust, actinal spinelets densely clustered). The thickness of skin around and on the spinelets can influence the shape and height/width ratio of the spinelets. Finally Cherbonnier and Guille (1975) have reported specimens from Kerguelen up to R = 22 mm, similar in size to material from Macquarie Island.

This species belongs in the Ganeriidae as defined by A.M. Clark (1983), having a rounded ventrolateral arm surface, small block-like marginals, lacking internal arm structures (fig. 2) and in lacking pedicellariae. A.M. Clark (1983) suggested that *Cycethra* should be monotypic given the extreme polymorphism of the type species *C. verrucosa* (Philippi, 1857). However, I can find no reliable character that would distinguish the two species at a generic level. On the other hand *C. frigida* is clearly distinguished from the related genera *Ganeria* and *Perknaster* by the presence in *C. frigida* of clusters of small spinelets on the abactinal, marginal and actinal plates. Specimens of *C. verrucosa* can vary from having abactinal plates with paxillae to low cresentic mounds (metapaxilliform) and marginal plates from small and inconspicuous to block-like and distinctive (A.M. Clark, 1983). *C. frigida* is similar to specimens of *C. verrucosa* with metapaxilliform abactinals and block-like marginals. *C. verrucosa* can be distinguished from *C. frigida* by the greater number (to 8) of adambulacral spinelets.

Goniasteridae

Ceramaster patagonicus Sladen

Plate 1d

Ceramaster patagonicus Sladen, 1889: 269, pl. 46 figs 3, 4, pl. 49 figs 3, 4.— Rowe and Gates, 1995: 65.—A.M. Clark, 1993: 249.— Branch et al., 1993: 44.

Ceramaster grenadensis patagonicus.—A.M. Clark and Downey, 1992: 236–237, figs 39e, f, pl. 55e–f.

Ceramaster lennoxkingi McKnight, 1973a: 178–180, fig. 4.—McKnight, 1984: 142. [new synonymy]

Material examined. Macquarie Island, ANARE 1986 Expedition, BT3, NMV F76237(1).

Description of Macquarie Island material. R = 75 mm, r = 58 mm. Body flat, pentagonal; interradial margins slightly concave; arm tips slightly upturned. Abactinal plates tabulate, large and hexagonal in centre of disc, smaller and quadrangular interradially; plates with approximately 12 marginal and 12–15 central granules (rarely to 24 marginal and 24 central spinelets), granules squat and polygonal. 2-jawed spatulate pedicellariae on some abactinal, marginal and actinal plates, larger than granules, usually widely open. Marginals conspicuous, 28 from arm tip to tip, covered in granules except in centre of superomarginals where 1–2 pedicellariae usually present. Actinal plates as abactinals, larger ones with 30 close-set granules. Adambulacral plates with 3–4 furrow spines and to 7 subambulacral spines in 2 longitudinal rows. Oral plates with 2 rows of 5–7 small angular spines along margin; 5 large and 5–8 smaller suboral spines. 2 rows of suckered tube feet.

Colour. Macquarie Island specimens (in alcohol) tan. Live Atlantic specimens are reddish orange above, cream below (A.M. Clark and Downey, 1992).

Habitat. Sand, mud (Sladen, 1889); rock (Branch et al., 1993).

Distribution. North Pacific, Bering Sea, Gulf of California, Burwood Bank Antarctica, Falkland Islands (106–192 m); Marion Island (527 m); Macquarie Island (105–148 m); the South Island and subantarctic islands of New Zealand (252–1125 m); southern Australia (no depth recorded).

Remarks. McKnight (1973a) distinguished his new species *C. lennoxkingi* from *C. patagonicus* by the more numerous abactinal spinelets and the fewer subambulacral spines. However, his specimens (R = 30–51 mm) were considerably smaller

than the holotype of *C. patagonicus* (R = 68 mm) and the distinction between the two nominal species appears to be size related. The present specimen conforms broadly to both descriptions. Branch et al. (1993) figured four large oral spines on a specimen from Marion Island, which is possibly a different species if this characteristic is constant.

Poraniidae

Porania antarctica Smith

Plate 1e

Porania antarctica Smith, 1876: 108.—Fisher, 1940: 154, A.M. Clark, 1962: 34.—Branch et al., 1993: 46. A.M. Clark, 1993: 232.

Porania glaber Sladen, 1889: 360-362, pl. 59 figs 1, 2.

Porania antarctica antarctica.—McKnight: 1984: 142.

Material examined. Macquarie Island, AM 1977–1978 Expedition, Caroline Cove (13–18.3 m), MA-303(1), MA-311(1); ANARE 1986 Expedition, BT2, NMV F60278(1); BT4, NMV F76226(1). Heard Island, Camp Beach 16 Aug 1951, washed up after storm, NMV(6); SW Beach, Aug 1951, NMV F75926(1).

Description of Macquarie Island material. R to 59 mm, r to 25 mm, height to 25 mm. 5 arms, broadly triangular. Disc high, madreporite small at top of interradial margin. Disc and arms covered in thick skin obscuring underlying skeleton. Dorsal spines thick, tapered to blunt tip, up to 2.2 mm high, twice as high as wide, smaller distally. Spine distribution on arms variable, NMV F60278, R = 25 m, with 1 carinal and 1 lateral longitudinal row of 6 spines; R = 50 mm (MA-303), with carinal row of 15 spines and 2 lateral rows of 10 spines; R = 59 mm (MA-311), with sinuous carinal row of 30 spinelets and 4–8 lateral spinelets not organised into longitudinal rows. Some spines scattered on disc, occasionally 2 close together. Clusters of 1–10 papulae scattered amongst dorsal spines. Marginal spines slightly thinner than dorsal spines, slightly flattened, sometimes truncate, 1, sometimes 2, spines per plate, to 2.2 mm long. Ventral disc skin with notable radial striations (fascioles), no papulae, no spines. 2, distally 3, furrow spines, outer spine largest, flattened and truncate, inner spines smaller, subcylindrical, each orientated obliquely to furrow. 2 oral spines at jaw apex, 2–3 small, pointed spines along furrow edge, 0–1 suboral spines. 2 series of tube feet. No pedicellariae.

Reproduction. Macquarie Island specimens with gonads attached to the interradial septa, genital pore situated abactinally; gonad consisting of a dense bunch of branching tubules, to 12 mm long, containing abundant eggs, eggs to 0.5 mm dia. Specimens of *P. antarctica* from McMurdo Sound, Antarctica, have numerous eggs (30,000–40,000), average size 0.55 mm dia, which develop into pelagic feeding larvae (Bosch, 1989).

Colour. Macquarie Island specimens (preserved) are off-white with brown tube feet. Branch et al. (1993) reported their Marion Island specimens as being a pink colour. Fisher (1940) recorded one live Falkland Island specimen as scarlet.

Habitat. The two Australian Museum specimens were collected amongst *Codium* or red algae adjacent to dense *Macrocystis* beds growing on boulders. Branch et al. (1993) recorded Marion Island specimens from rock, sand and sand with > 5% mud. Sladen (1889) recorded a juvenile specimen from the abyssal plain near the Crozet Islands (2976 m).

Distribution. Antarctica (12–1335 m), Magellanic region, South America north to 35°S (18–320 m), Prince Edward Islands (10–280 m), Crozet (2976 m), Kerguelen (shore–23 m), Heard Islands (shore–150 m); Macquarie Island (13–105 m).

Remarks. The present specimens have strongly developed dorsal and marginal spines similar to those found on specimens from Marion Island (A.M. Clark, 1962) and Kerguelen (Guille, 1974). Several subspecies have been proposed by Fisher (1940) and A.M. Clark (1962), however, they are not clearly distinguished either morphologically or geographically. There is an undescribed species recorded from McMurdo Sound in the Ross Sea (A.M. Clark, 1962; H.E.S Clark, 1963; Bosch, 1989). This species is distinguished by the smaller body size (R to 30 mm), genital pores located on the oral surface, the relatively few eggs (100–310), and the development of lecithotrophic demersal larvae. Other small paucispinous specimens from eastern Antarctica may prove to be a third species (A.M. Clark, 1962). The trinomial *P. antarctica glabra* Sladen, 1889 has been used for these animals (e.g., H.E.S. Clark, 1963; McKnight, 1976; Mein, 1992) but this is inappropriate as the type of *P. glabra* is from Kerguelen where it falls within the range of variation shown by specimens of *P. antarctica* (A.M. Clark, 1962).

Order Velatida

Solasteridae

Solaster notophrynus Downey

Plate 1g–h

Solaster notophrynus Downey, 1971: 39–42, fig. 1.—A.M. Clark and Downey, 1992: 305, pl. 73e–f. A.M. Clark, 1996: 193.

Solaster dianae Stampanato and Jangoux in Branch et al., 1993: 45 [in key with figures] [new synonymy].

Solaster dianei.—Stampanato and Jangoux, 1993: 183.

Material examined. Macquarie Island, ANARE 1986 Expedition, BT8, NMV F60290(1); Australia, off Northwest Tasmania, 41°06′S, 143°50′E, 1110–1300 m, NMV F82065(1).

Comparative material examined. Solaster subarcuatus Sladen, 1889: Antarctica, Enderby Land, 65°48′S, 53°16′E, 209–180 m, 24 Jan 1930, BANZARE stn 41, SAM K1453(6); Australia, off Port MacDonnell, 800–1000 m, AM J17796(1).

Description of Macquarie Island material. R = 40 mm, r = 11 mm. 7 arms, widened at base, tapering rapidly after half R to blunt, round tip; madreporite indistinct, slight interradial sulcus. Abactinal plates in close regular reticulum, usually quadrilobed, imbricating with neighbouring plates. Paxillae small with low widened pedicel, to 0.6 mm high, bearing 5–15, low cylindrical blunt, thorny, spinelets, to 0.15 mm long. Abactinal paxillae 0.4–0.6 mm diameter, larger in interradial disc sulcus, to 0.8 mm diameter, smaller adjacent to marginals. Papular areas small with usually 1 papula, papulae present on disk and arms. Paxillae on disc and lateral arm surfaces in regular oblique rows, plates on dorsal arm surfaces less regularly arranged, sometimes trilobed with 2 papulae between plates.

Superomarginals similar to abactinals, slightly larger than abactinals on smaller specimen, much smaller than inferomarginals; paxillae with up to 12 spinelets. Proximal plates alternate in position with inferomarginals, other plates aligned transversely. Inferomarginals large, 31 plates along arm, separated by less than their height. Paxillae with high, laterally compressed pedicels, up to 30 short conical, terminally thorny, spinelets (mostly broken) in 3–4 transverse rows. 5 series of actinals on ventral disc area, only 1 series persists after 14th marginal (two-thirds R), paxillae small, with 5–8 spinelets. No actinal papulae.

Adambulacrals narrow, widely separated, 43 along arm; with 3–5 long tapered webbed furrow spines in finger-like spread, to 1.5 mm long; 6–14 long thin subambulacral spines, largest near furrow, to 1.1 mm, subequal with furrow spines, not webbed, some thickened at tip. First adambulacral plate on smaller specimen with 5 furrow spines and 14 subambulacral spines in 3 transverse rows. Next few plates with 4 furrow spines and 1–2 rows of subambulacrals. Plates at half R with 3 furrow and 8 subambulacral spines in a single transverse row. Distal plates with 3 furrow and 6 subambulacral spines.

Oral plates widened and tumid; 10 furrow spines, webbed at their base, innermost 2–3 enlarged and pointed, to 2.0 mm, lateral spines interleave with spines on opposing jaw, up to 25 suboral spines on raised section of plate, inner few enlarged, terminally thorny, rest small, conical. Oral suture wide and bare. 2 series of tube feet.

Reproduction. Macquarie Island specimen female; gonads small, shaped like bunch of grapes, attached to dorsal end of interradial arc; numerous eggs, 0.2 mm dia.

Colour. Macquarie Island specimens (in alcohol) white. Atlantic specimens dark-reddish brown (Downey, 1971).

Habitat. Marion specimens recorded from rock (Branch et al., 1993)

Distribution. Northwestern Atlantic (660–1230 m), Prince Edward and Marion Islands (335–475 m), Macquarie Island (330–450 m), Australia (1100–1300 m).

Remarks. Solaster notophrynus is characterised by the numerous suboral and subambulacral spines (pl. 1h), the small dense abactinal paxillae arranged in regular transverse and oblique series, and the shape and number of the arms (pl. 1g). The specimen from Australia is larger (R=70 mm) than the Macquarie specimen but differs only in having slightly fewer subambulacral spines. A similar species *Solaster dianae*, has been recently recorded from Marion and Prince Edward Islands (Branch et al., 1993). A full description of this species has not been published, however one of the authors (S. Stampanato) has kindly supplied me with a description and photos of the holotype. *S. dianae* is very similar in general appearance to *S. notophrynus*, the only apparent difference being that the superomarginal plates are distinct in *S. dianae* but indistinguishable from the abactinal plates on the holotype of *S. notophrynus*. This

feature is variable on the arms of the two specimens I have examined and there appears to be no reason to retain *S. dianae* as a separate species.

Solaster is predominantly a northern hemisphere genus. The other exceptions are *S. torulatus* Sladen, 1889, known from off New Zealand and the Kermadec Islands in 1042–1116 m; *S. longoi* Stampanato and Jangoux, 1993 from the Enderby quarter of Antarctica; *S. subarcuatus* Sladen, 1889 from Kerguelen and southern Australia; and *S. regularis* Sladen, 1889 from throughout the Southern Ocean (although not yet from Macquarie Island). These species have fewer spines and spinelets, and with the exception of *S. torulatus* larger paxillae and more arms (8–10). *Solaster* differs from the closely related *Crossaster* by the smaller, denser abactinal paxillae, arranged into oblique rows.

Crossaster multispinus H.L. Clark

Plate 1f

Crossaster multispinus H.L. Clark, 1916: 66, pl. 18 figs 5, 6.—H.L. Clark, 1946: 150.—Rowe and Gates, 1995: 113.

Material examined. Macquarie Island, ANARE 1986 Expedition, BT8, NMV F60291(1).

Australia, Tasmania, Bruny Island, 270–314 m, AM E5078(2 syntypes); Eastern Bass Strait, 39°11.3′S, 148°41.2′E, 440–464 m, 6 Feb 1985, NMV F82985(1); 39°3.3′S, 148°38.0′E, 435–480 m, 6 Feb 1985, NMV F82986(1).

Description of Macquarie Island material. R = 23 mm, r = 12 mm. 10 short arms, tapered evenly to blunt tip. Abactinal plates in irregular open reticulum, paxillate with thick pedicel and bristling crown of 15 long sharp spinelets (mostly broken), with 3–4 narrow connecting bars to neighbouring plates. Large papular areas with 1–2 papulae, smaller paxillae developing within papular areas with 1–4 spinelets. Superomarginals similar to abactinals; inferomarginals large, 14 along arm, laterally compressed, widely spaced, separated in middle of arm by more than their height, pedicel large, thick, bearing to 30 long, serrated, spinelets (to 1.3 mm long) in 3–4 transverse rows; some smaller paxillae interspersed. Actinal disc area with up to 3 rows of small sparse paxillae, not extending onto arm. Adambulacrals with 5–6 long slender tapered, slightly serrated furrow spines (mostly broken), webbed to third of their height, to 7 subambulacral spines in transverse row or arc, to 1.45 mm long, decreasing in height away from furrow, slightly larger than furrow spines, flattened, webbed but not joined by web to furrow spines. Oral plates widened with up to 11 webbed furrow spines, innermost 4 enlarged, up to 10 suboral spines on raised section of plate, increasing in size towards apex.

Colour. Macquarie Island specimen (in alcohol) white, tube feet brown. Live colour of an Australian specimen (NMV F82985) dull yellow-olive dorsally with paler arm tips.

Habitat. Unknown.

Distribution. South eastern Australia, New Zealand (90–1152 m); Macquarie Island (330–450 m).

Remarks. This specimen is the first record of *Crossaster* from Macquarie Island. It closely matches the description of H.L. Clark (1916). It was compared with syntypes of *C. multispinus* and several other specimens from southern Australia in Museum Victoria. The only slight differences are in the length of the inferomarginal spinelets and the number of arms, which is almost always 11 on Australian specimens.

H.B. Fell (1958) synonymised *C. multispinus* with *C. japonicus* (Fisher, 1911) from Japan after examining several specimens from New Zealand. Rowe and Gates (1995) have disagreed and retained the name *C. multispinus* for Australian specimens. The identity of the New Zealand specimens is unclear, but judging from the descriptions and figures of H.B. Fell (1958) and H.E.S. Clark (1970), they appear conspecific with the Australian and Macquarie Island species. A similar species, *C. penicillatus* (Sladen, 1889), is known from off South Africa, Marion Island, Tristan da Cunha, and Gough Island from 55–800 m (A.M. Clark and Downey, 1992). It differs in having slightly fewer spinelets, 10 on abactinal plates, 15 on inferomarginals, 4–5 furrow spines, and has 8–11 (usually 10) arms. *C. campbellicus* McKnight, 1973d from off New Zealand has 10 arms but differs in having fewer spinelets, only 2–5 on abactinal plates.

Pterasteridae

Pteraster affinis Smith

Pteraster affinis Smith, 1876: 108.—Koehler, 1917: 48, pl. X fig. 11.—A.M. Clark and Downey, 1992: 326.—A.M. Clark, 1996: 206.

Pteraster affinis affinis.—A.M. Clark, 1962: 63, text-figs 10f, g.

? Hymenaster sp. (juv).—A.M. Clark, 1962: 67.

Material examined. Macquarie Island, AM 1977–1978 Expedition, Caroline Cove (8 m), MA-300 AM J22731(1); Kerguelen, Royal Sound, 2–20 m, 10 Feb 1930, BANZARE stn 49, SAM K1461(1); Bras

Bolinder, 20–30 m, 14 Feb 1930 BANZARE stn 53, SAM K1462(2); Heard Island, Camp Beach 16 Aug 1951, washed up after storm, NMV F76183(1).

Comparative material examined. Hymenaster sp.: Macquarie Island, Off Lusitania Bay, 54°42.58′S, 158°54.5′E, 69 m, 5 Dec 1930, BANZARE stn 83, SAM K1469(1).

Description of Macquarie Island material. R = 13 mm, r = 7 mm; 5 arms, short, triangular, blunt tip; interradial arcs rounded. Abactinal plates paxillate; 2–6, usually 4, subequal paxillar spinelets, thin, slightly flattened, to 1.0 mm long, slightly serrated or widened at tip, fenestrated surface. Paxillar pedicel small, twice as high as wide. Thick, pulpy supradorsal membrane connecting spinelets at midheight. Actinolateral fringe of spines connected by continuous webbing along arm, spines flat, striated, truncate tip, to 2.0 mm long. 4 webbed adambulacral spines in transverse row near furrow. 5 webbed marginal spines on each oral plate, webbing not continuous over jaw apex; 1 large suboral spine, distally directed, largely covered in membrane, tricarinate near pointed tip. 2 rows of suckered tube feet.

Reproduction. Macquarie Island specimen female, gonad mass small (2 mm wide) consisting of a bunch of short transparent tubules with 2–3 eggs; approximately 30 eggs per gonad; eggs elongate, to 0.4 mm long. Gonad is attached near the dorsal margin of the arm, near to the interradial arc.

Colour. (In alcohol) tan.

Habitat. The Macquarie Island specimen was found on boulders in a dense *Macrocystis* bed at 8 m. Branch et al. (1993) recorded their Marion Island specimens from rock, sand and gravel.

Distribution. Antarctica (0–603 m), Magellanic region (0–740 m), Kerguelen (0–91 m), Heard Island (shore), Macquarie Island (8 m), Marion Island.

Remarks. The condition of the specimen is poor; many spines are broken and the animal is quite flaccid. Nevertheless, enough diagnostic characters are visible to fully identify the specimen, including the large erect suboral spine, and the number and webbing of spinelets. A.M. Clark (1962) recognised three subspecies of *P. affinis* that surround the Southern Ocean: *P. affinis lebruni* Perrier, 1891 reported from Argentina, the Falkland/Magellan region and the Prince Edward Islands; *P. affinis aculeatus* Koehler, 1920 occurring in eastern Antarctica from Kemp Land and the Ross Sea; and *P. affinis affinis* from Kerguelen. However, A.M. Clark and Downey (1992) point out the overlap between these supposed subspecies and the close relationship of *P. affinis* with *P. militaris* from the Arctic. The Kerguelen specimens that I have examined are very similar to those from Macquarie and Heard Islands, differing only in having thicker opaque webbing between the spinelets, but this may be due to differences in preservation.

McKnight (1984) recorded a small specimen (R = 17 mm) of *P. stellifer stellifer* Sladen, 1882 from Macquarie Island. Sladen (1889) described this species as having five marginal oral spines not connected by webbing, a smaller proximally directed suboral spine, and regular "stellate" abactinal paxillae with six subequal spinelets. I have not been able to examine McKnight's specimen but it appears from the description to differ from the type in having up to 7–9 spinelets on the abactinal paxillae, the peripheral spinelets (0.75 mm long) truncate, tapering slightly and the central spinelet long (1.5 mm) stout and non-tapering. More specimens are required to clarify the relationship. A.M. Clark (1962) recognised two subspecies of *P. stellifer*, *P. stellifer hunteri* Koehler, 1920 differing from *P. stellifer stellifer* in having flared paxillar spinelets. However, subsequently A.M. Clark and Downey (1992) list *P. hunteri* as a synonym of *P. stellifer* without comment. *P. stellifer* has been recorded from southern South America and around Antarctica (79–2084 m), including the Balleny Islands (McKnight, 1976 as *P. stellifer hunteri*)

A.M. Clark (1962) has also recorded a tiny specimen (R = 3.5 mm) of a undetermined *Hymenaster* species from Macquarie Island which I have examined. The oral and adambulacral spines lack webbing as is characteristic of *Hymenaster*. The specimen has approximately 20 abactinal paxillae with 5–8 spinelets, the middle 1–3 longest, 2–3 subambulacral spines, two oral and one small suboral spine. The specimen is obviously a juvenile, possibly even a juvenile of one of the *Pteraster* species listed above, and its true affinities cannot yet be determined.

Order Spinulosida

Echinasteridae

Henricia obesa (Sladen)

Plate 2a

Cribella obesa Sladen, 1889: 544–45, pl. XCVI figs 3, 4, pl. XCVIII figs 5, 6.

Henricia obesa.—Fisher, 1940: 164.—A.M. Clark, 1962: 48, figs 5n, 6a–c.—McKnight, 1984: 143.—Rowe and Albertson, 1987: 190–192, figs 2a, b.—A.M. Clark and Downey, 1992: 392–393, fig. 60s, pl. 95a.—A.M. Clark, 1996: 237.

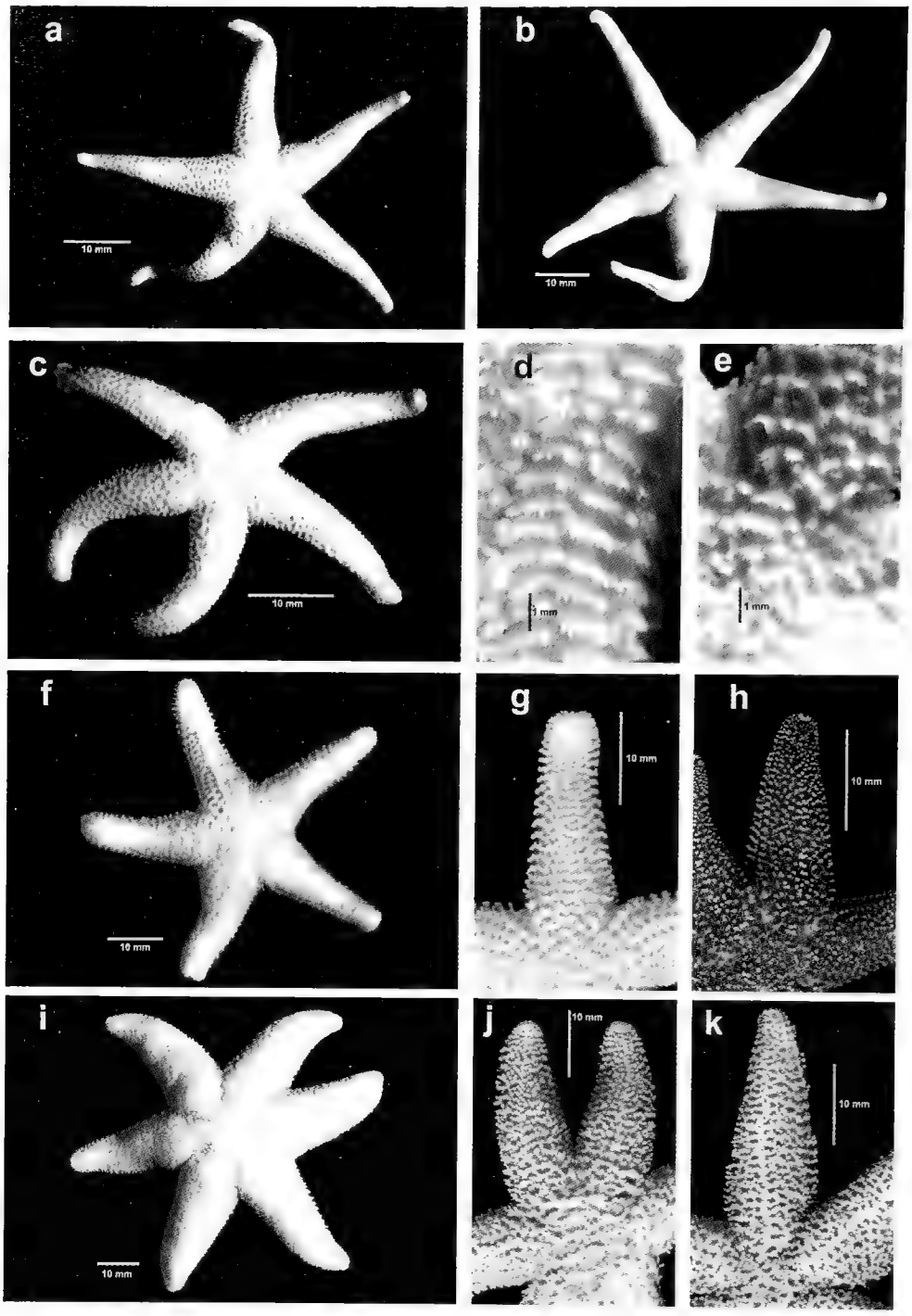

Plate 2. a, *Henricia obesa*, dorsal view, NMV F60281; b, *Henricia studeri*, dorsal view, NMV F60287; c, *Odontohenricia anarea*, paratype, dorsal view, NMV F60289; d, *Odontohenricia anarea*, adambulacral and marginal spinelets, NMV F60289; e, *Odontohenricia anarea*, abactinal spinelets, NMV F60289; f, *Anasterias directus*, dorsal view, NMV F77766; g, *Anasterias directus*, dorsal view of arm (skin removed on upper arm), NMV F76241; h, *Anasterias directus* "*antarctica* form", dorsal view of arm, NMV F76242; i, *Anasterias mawsoni*, dorsal view, NMV F76170; j, *Anasterias mawsoni*, dorsal view of arm, NMV F76164; k, *Anasterias mawsoni* "*sphoerulatus* form", dorsal view of arm, NMV F76181.

Henricia lukinsi.— McKnight, 1984: 143 [non *H. lukinsi* (Farquhar, 1898)].

Henricia sp. aff. *obesa*.—O'Hara, 1998a: 146.

Material examined. Macquarie Island, AM 1977–1978 Expedition, Caroline Cove (8–18 m), MA-298 AM J22732(1), MA-300 AM J22730(1), MA-303 AM J22733(1), MA-306(1). ANARE 1986 Expedition, BT2, NMV F60281(13); BT3, NMV F60280(3); BT4 NMV F76223(7); BT5, NMV F60282(1); BT10, NMV F60279(2); off Lusitania Bay, 54°42.5′S, 158°54.5′E, 69 m, 5 Dec 1930, BANZARE stn 83, SAM K1449(4) and BMNH, 1965.8.5.108–110(4); 54°23.9′S, 158°59.3′E, 183 m, NZOI stn A698, identified by McKnight (1984) as *H. lukinsi*, NIWA(1).

Falkland Islands, Port William, 51°40′S, 57°50′W, 22 m, 26 Jan 1876, sand/gravel, *Challenger* stn 315, BMNH 90.5.7.831–3 (holotype and paratypes of *H. obesa*); *Discovery* stns WS 81,84, 85, 86, 93, 220, 75–151 m, identified by Fisher (1940), BMNH, 1948.3.16.467–470(4).

Australia, New South Wales, Shoalhaven Bight, 512 m, identified by Rowe and Albertson (1987), AM J13288(7); Victoria, East of Gabo Island, 410–450 m, identified by Rowe and Albertson (1987), AM J18628(3).

Comparative material examined. *H. aucklandiae* Mortensen, 1925: Auckland Island, Carnley Harbour, 29 Nov 1914, ZMUC(syntype); Figure Eight Island, 2 Dec 1914, ZMUC(syntype); Masked Island, 3 Dec 1914, ZMUC(syntype); Chatham Islands, low tide, identified by H.B. Fell (1960), BMNH, 1952.4.16.17(2). *H. lukinsi* (Farquhar, 1898): Auckland Island, Carnley Harbour, Figure Eight Island, 2 Dec 1914, identified by Mortensen (1925), ZMUC(1); Auckland Island, Laurie Harbour, *Discovery* Expedition, 1904, identified by A.M. Clark (1962), BMNH 1905.7.14.10(1); Campbell Island, off East Cape, 18 m, 13 Jan 1980, AM J22905(1).

Description of Macquarie Island material. R = 9–46 mm, r to 10 mm; 5 equal subcylindrical or flattened arms (1 specimen with 6 arms NMV F60281), sometimes inflated at base, slender distally, tapering to round tip, tip often curled. Abactinal plates in coarse reticulum, papular areas largest on base of arm, to 1.5 mm dia., with 3–9 papulae, secondary plates sometimes present in papular areas, few papulae on disc. Abactinal plates with irregular row of 1–6 short stout, tapered or slightly capitate, terminally thorny spinelets, l/w = 1.5–2 (3 when skin is removed), to 0.4 mm high. Superomarginals quadrilobed or rhomboidal with up to 6 spinelets clustered on dorso-distal side of plate. Inferomarginals quadrilobed, imbricating, 6–8 spinelets in irregular transverse row. Usually 1 series (sometimes 2–3 series on specimens R > 40 mm) of bar-like intermarginals extending to quarter R with 2–4 spinelets in transverse row. Actinals square-shaped, extending to two-thirds R, with 2–4 spinelets, 3–10 bar-like plates in second series proximally, to half R on largest specimens. Marginal and some actinal papulae present. 10 adambulacrals to 7 inferomarginals, 1 slender spine in furrow, 1–2 large club-shaped spines on furrow edge, 3–5 subambulacral spines in 1 (smaller specimens) or 2 (larger specimens) rows. Oral plates each with 3–5 furrow spines, innermost enlarged, 1–3 suboral spines. Some actinal papulae.

Reproduction. AM Expedition specimens with gonads consisting of several tubules with 2 3 rows of short lateral branches or lumps, attenuating is size distally; sexes separate, female gonads with eggs of varying size classes, 0.1–1.2 mm dia, large eggs relatively few in number.

Colour. Macquarie Island specimens (in alcohol) dark brown, tan or off-white, with yellow-brown adambulacral area, brown tube feet. Fisher (1940) recorded the live colour of Falkland Islands specimens as orange-yellow, paler distally.

Habitat. The four AM Expedition specimens from Caroline Cove were found amongst a dense *Macrocystis* bed (8–18 m). McKnight's (1984) record of a Macquarie Island specimen from "0 m" at Sandy Bay was presumably a beach-washed specimen. Falkland Islands specimens were recorded from coarse sand, fine sand, stones, gravel, shell (Fisher, 1940). A Marion Island specimen has been collected from rock (Branch et al., 1993)

Distribution. South America, Falkland Islands (22–450 m); Marion Island (527 m); Macquarie Island (8–433 m); southeastern Australia (73–604 m).

Remarks. I have followed A.M. Clark (1962) and McKnight (1984) in referring these specimens to *H. obesa*. This species is characterised by an open skeleton, robust abactinal spinelets arranged in 1–2 rows along the plates, and adambulacral spinelets also arranged in 1–2 transverse rows. However, there are some slight differences that distinguish the Macquarie Island material from specimens from South America and Australia. These latter specimens (including the types) have consistently smaller (0.2–0.3 mm) and more numerous abactinal spinelets. Up to 15 spinelets occur in 2 (or even 3) rows along the abactinal plate. Larger animals have a more open skeleton with more secondary calcification than Macquarie specimens of the same size. Many authors, including Fisher (1940) and Hayashi (1941), have commented on the extreme difficulty in

identifying *Henricia* material and I refrain from establishing a new species on the basis of such small differences.

McKnight (1984) has recorded two additional *Henricia* species from Macquarie Island that are otherwise known from the subantarctic islands of New Zealand: *H. aucklandiae* Mortensen, 1925 and *H. lukinsi* (Farquhar, 1898). I have examined a specimen identified by McKnight as *H. lukinsi* and one as *H. aucklandiae*. The *H. lukinsi* specimen is identical to my *H. obesa* material. The specimen of *H. aucklandiae* has numerous spinelets and is referable to *H. studeri* (see below).

H. lukinsi material from New Zealand can be distinguished from *H. obesa*. *H. lukinsi* is a small species (R to 24 mm) with adambulacral, actinal and marginal spinelets aligned in a prominent row on each transverse series of plates. Other notable features include the denticulate nature of the abactinal spinelets, and a shallow depression in each interradial disc area. On the other hand New Zealand specimens of *H. aucklandiae* are very similar to *H. obesa* differing only in having a slightly more compact skeleton and *H. aucklandiae* appears to be no more than a regional variant of *H. obesa*. Large specimens of *H. aucklandiae* (R=37 mm) have 7–9 adambulacral spinelets (0.25 mm high) in two rows, 15–18 abactinal spinelets in clusters or in two rows, a single row of actinal plates extending almost to the ray tip and some intermarginal plates at the base of the arm. Molecular or developmental studies are required to determine whether the difference between all these regional forms are of specific or infraspecific rank.

Henricia studeri Perrier

Plate 2b, Figure 3a–c

Henricia studeri Perrier, 1891: 102–103, pl. 9 fig. 2.—Fisher, 1940: 163–164, pl. 11 fig. 1.—A.M. Clark and Downey, 1992: 398, fig. 60n.—A.M. Clark, 1996: 242.

Henricia aucklandiae.—McKnight, 1984: 143 [non *H. aucklandiae* Mortensen, 1925].

Material examined. Macquarie Island, ANARE 1986 Expedition stn BT2, NMV F60286(2); NMV F60287(1); BT3, NMV F60285(1); BT4 NMV F76224(1); BT8, NMV F60287(1); BT10, NMV F60283(1); off Buckles Bay, 372 m, Feb 1967, NMV F60284(1); 54°59.7′S, 158°36.4′E, 155–198 m, NZOI stn E236a, identified by McKnight (1984) as *H. aucklandiae*, NIWA(1).

Falkland Islands, *Discovery* stns WS 81, 85, 86, 872, 147–151 m, identified by Fisher (1940), BMNH 1948.3.16.453–465(12).

Comparative specimens examined. H. compacta (Sladen, 1889): West of New Zealand, 38°50′S, 169°20′E, 510 m, 23 Jun 1874, *Challenger* stn 166, BMNH 90.5.7.830(holotype); Australia, off Tasmania, 42°43′S, 148°25′E, 506 m, 25 Jun 1984, NMV F76238(1). *H. abyssalis* (Perrier, 1894): South Africa, off Cape of Good Hope, 304 m, BMNH, 1903.8.1.80(2).

Description of Macquarie Island material. R = 18–38 mm, r to 7 mm, arms 5, elongate, slender, tapered, cylindrical, slightly inflated at base, usually curled at tip. Disc small; anus central, noticeable; madreporite small, at interradial margin. Abactinal plates in irregular compact reticulum, papular areas not large, to 0.45 mm dia., with 2–3 papulae, little secondary calcification, no accessory plates. Plates quadrilobed or trilobed, imbricating with 2–4 neighbouring plates, with small cresentic central raised section, 3–30 clustered spinelets per plate, to 5 wide, spinelets l/w = 4–6, with 2–4 minute thorns at the tip, to 0.2 mm high. Marginals clearly visible in regular longitudinal rows. Superomarginals quadrilobed or irregular, imbricating, with thickened distal edge, up to 30 spinelets, similar to abactinal spinelets. Inferomarginals larger, quadrilobed or rhombic, with thickened proximal edge, up to 40 spinelets (to 0.14 mm long), few intermarginal plates present at greatest arm breadth (fifth R), similar to superomarginals. 1 series of actinals extend the arm length, closely imbricating, distal edge thickened, 10–20 spinelets, in clusters or in 3 transverse rows on proximal plates. 1 adambulacral plate to every inferomarginal. 1, sometimes 2, small spines in furrow; 2, sometimes 3, large stout capitate spines at furrow edge (to 0.55 mm long), with 7–10 subambulacral spines, in 2–3 transverse rows, spine height decreasing away from furrow, some thorny. Marginal and actinal papulae present even at arm base. Oral plates each with 3–4 furrow spines, innermost enlarged (0.6 mm long), 2 suboral spines.

Colour. Macquarie Island material (in alcohol) off-white. A.M. Clark and Downey (1992) recorded live colour of Atlantic specimens as orange-yellow to light red above, dull yellow below. Marion Island specimens are pale (Branch et al., 1993).

Habitat. Coarse sand, shell, stones (A.M. Clark and Downey, 1992); rock (Branch et al., 1993).

Distribution. South America, Falkland Islands (74–430 m), Prince Edward Islands (474–527 m), Macquarie Island (100–450 m), Marion Island.

Remarks. Henricia studeri is related to several other *Henricia* species that circle the Southern

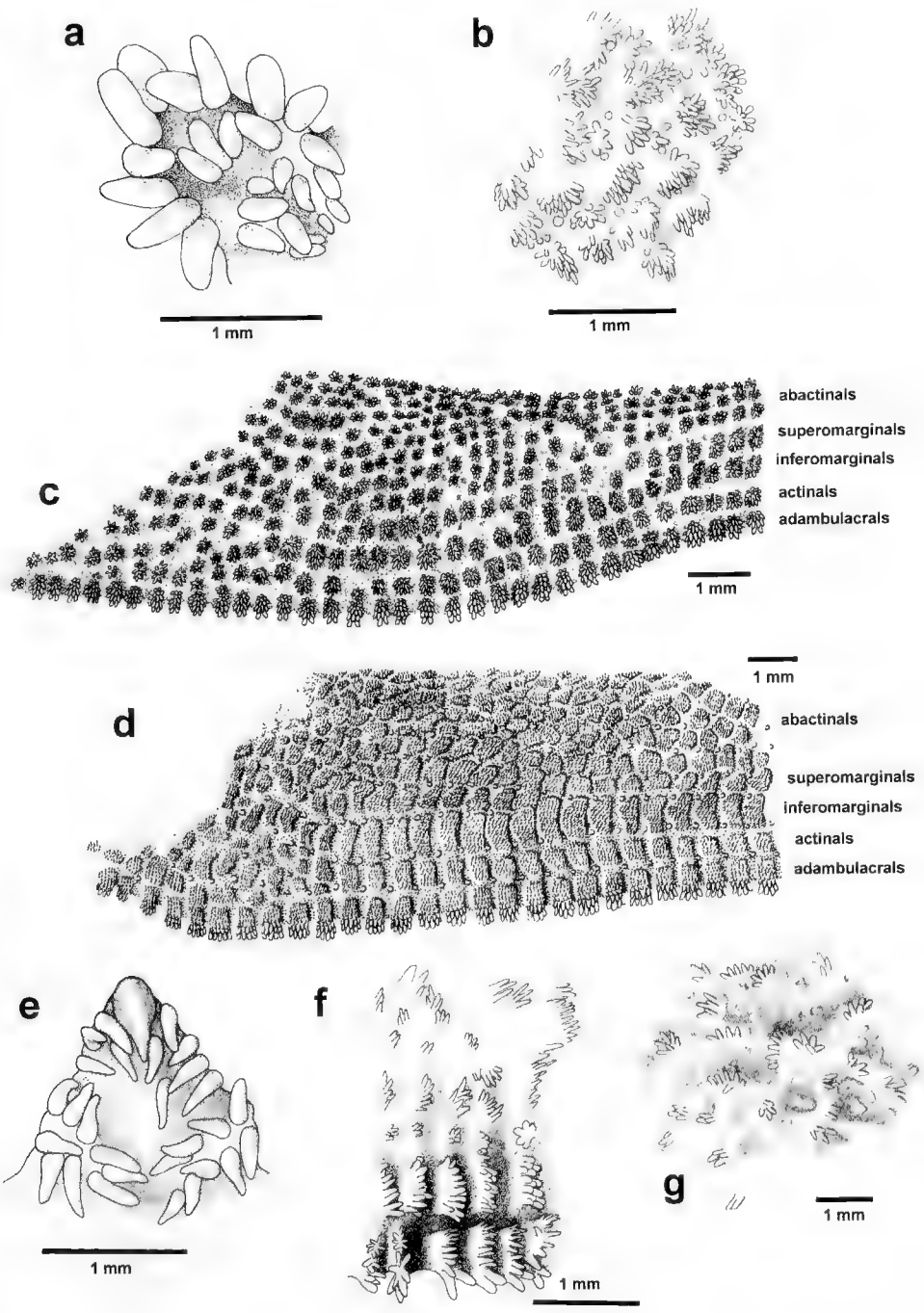

Figure 3 a–c, *Henricia studeri*, NMV F60287: a, detail of a jaw showing the position of the oral spinelets; b, detail of dorsal arm surface showing arrangement of abactinal spinelets; c, ventrolateral view of the base of an arm, showing the arrangement of marginal plates. d, *Henricia compacta*, NMV F72238: ventrolateral view of the base of an arm, showing the arrangement of marginal plates. e–g, *Odontohenricia anarea*, holotype, NMV F60288: e, detail of a jaw showing the position of the oral spinelets; f, ventrolateral view of a section of an arm; g, detail of dorsal arm surface showing arrangement of abactinal spinelets.

Hemisphere including *H. compacta* (Sladen, 1889), *H. abyssalis* (Perrier, 1894) and *H. praestens* (Sladen, 1889). These species were characterised by A.M. Clark (1962) as having a large numbers of spinelets, two furrow spines and a extensive row of actinal plates, usually extending to the arm tip. The Macquarie Island specimens conform to the descriptions given by Perrier (1891) and A.M. Clark and Downey (1992) for *H. studeri*. They are identical to Falkland Islands material identified by Fisher (1940).

The Macquarie Island material was compared to the juvenile holotype of *H. compacta* and to larger specimens from off southeastern Australia. *H. compacta* differs from *H. studeri* in having a more compact abactinal skeleton, smaller, finer abactinal spinelets, and more subambulacral spines. The marginal plates on *H. compacta* are quite pronounced and often irregularly placed, particularly at the base of the arms (fig 3d), there being fewer superomarginal than inferomarginal plates. *H. praestens*, known from off Marion and Crozet Islands, has a secondary skeletal network, fewer dorsolateral spinelets, knob-shaped furrow spines and is an orange colour (Branch et al., 1993). *H. abyssalis* which has been found in deep water off South Africa is a much larger species with two series of actinal plates that continue to the arm tip.

Odontohenricia anarea sp. nov.

Plate 2c–e, Figure 3e–g

Odontohenricia sp. nov.—O'Hara, 1998a: 146.

Material examined. Holotype, off Judge and Clerk Rocks, 54°23.6′S, 158°59.3′E, 100 m, 10 Dec 1986, stn BT10, NMV F60288.

Paratypes, type locality and date, NMV F60289(2).

Other material. Macquarie Island, off Lusitania Bay, 54°42.5′S, 158°54.5′E, 69 m, 5 Dec 1930, BANZARE stn 83, SAM K1826(1).

Comparative material examined. O. clarkae Rowe and Albertson, 1988: South Africa, 34°33′S, 18°20′E, 290 m, BMNH 1987.4.9.1.1(holotype). *O. endeavouri* Rowe and Albertson, 1988: eastern Bass Strait, 38°9.1′S, 149°54.0′E, 440 m, NMV F82983(1).

Description. Holotype. R = 26 mm, r = 5 mm, br = 6 mm. Arms 5, cylindrical, slightly broadened at base, tapering gradually to rounded tip. Disc small, madreporite near interradial margin, anus central. Abactinal plates in reticulum, plates cresentic or bar-like, imbricating with 2–3 neighbouring plates, which surround sunken, round, oval or irregular papular areas, papular areas 0.7–1.3 mm dia. Raised ridge on plate bearing combs of 2–8 spinelets (typically 3–5), in 1, occasionally 2, rows. Spinelets small, slender, slightly capitate or tapered, minutely thorny (when skin removed), 0.3–0.5 mm high and 0.1 mm wide. Papular areas with 1–4 papulae around rim, often with an accessory plate in centre. Marginals distinct in regular transverse and longitudinal rows, to 40 along arm. Superomarginals quadrilobed, often irregular in shape, longer than wide, raised section on plate triangular or bar-like, with up to 10 spinelets in 2 transverse rows. Intermarginals bar-like, single row extending up to 14 plates along arm (half R), up to 4 spinelets clustered on proximal plates. Inferomarginals larger, quadrilobed or rhomboidal, with up to 16 spinelets in several rows, to 0.4 mm high. Actinals square or rectangular, extend to half R, with up to 7 spinelets in 1–2 rows. Marginal and actinal papulae present, usually 1 per area. Adambulacrals rectangular, 9 adambulacrals to every 7 inferomarginals, 1 upwardly curved spine inside furrow, 1–2 large, cylindrical blunt spines on furrow edge, l/w = 3 (4 when cleaned), to 0.8 mm, 5–6 subambulacral spines decreasing in height away from furrow, arranged in 2 transverse rows. Oral plates with large recurved spine apically, 3.0 mm long, 1.0 mm wide, tapering to a sharp point; 3–4 furrow spines, half as high as apical spine, 1–3 suboral spines.

Paratypes. R = 25 and 29 mm, r to 6 mm, br to 7 mm. Largest paratype differs from holotype in having short second row of superomarginal plates proximally and smaller oral spines.

Reproduction. Paratypes with short branched gonads attached at base of arms to lower dorsolateral surface. No eggs apparent.

Colour. (In alcohol) fawn or light orange, ventrally paler, brown tube feet.

Habitat. Unknown.

Distribution. Macquarie Island (69 -100 m).

Etymology. Latinised form of the acronym ANARE (Australian National Antarctic Research Expeditions), in recognition of its contribution to this research.

Remarks. The genus *Odontohenricia* Rowe and Albertson, 1988 is distinguished from *Henricia* and other echinasterids by the presence of a large recurved pointed spine at the apex of each jaw. Four species were previously known, all described by Rowe and Albertson (1988). *O. anarea* is closest in form to *O. clarkae*, known

from off South Africa. The holotype of *O. clarkae* was examined for comparison. It is in poor condition with much of the skin and spines removed, R = 33 mm. It differs from *O. anarea* in having slightly thinner arms (br = 6 mm), a finer abactinal skeleton (papular areas typically 0.6–1.0 mm dia.), more numerous but smaller abactinal spinelets (0.25 mm long, 0.04 mm wide), more numerous subambulacral spines (10–13 per plate), and a larger oral spine (to 1.2 mm).

O. hayashii from Japan differs in having thinner arms and a finer skeleton (papular areas appear to be 1.0 mm dia. in Rowe and Albertson, 1988, fig. 10), but otherwise has quite similar abactinal spinelets and marginal and adambulacral spines. *O. endeavouri* from off southern Australia has a finer skeleton consisting of stellate plates and isolated tufts of numerous small spinelets. *O. fisheri* from off the North Pacific coast of America has more numerous abactinal, adambulacral and oral spines.

Specimens of *Odontohenricia* have been misidentified as *Henricia* species in the past. They are often superficially similar and, as more specimens are collected, show the same minor variation in skeletal and spine arrangement that make *Henricia* specimens difficult to identify. One of the current specimens was amongst nine identified as *Henricia obesa* by A.M. Clark (1962). Apart from the lack of an enlarged oral spine, the Macquarie Island specimens of *H. obesa* differ in having a more open skeleton with fewer spinelets and spines.

Order Forcipulatida

Asteriidae

Smilasterias clarkailsa O'Loughlin and O'Hara

Smilasterias sp. cf. *irregularis*.—A.M. Clark, 1962: 87–88.

Smilasterias irregularis.—McKnight, 1984: 143 [non *S. irregularis* H.L. Clark, 1928].

Smilasterias clarkailsa O'Loughlin and O'Hara, 1990: 316, pl. 1f, g.

Material examined. Macquarie Island, off Lusitania Bay, 54°42.7′S, 158°54.50′E, 69 m, 5 Dec 1930, BANZARE stn 83, BMNH 1965.8.5.220 (paratype); 54°23.9′S, 158°59.3′E, 183 m, NZOI stn A698, identified by McKnight (1984) as *S. irregularis*, NIWA(1). ANARE 1986 Expedition, BT2, NMV F53754 (holotype), NMV F53755(paratype); BT3, NMV F53753(paratype). AM 1977–1978 Expedition, Garden Cove (11–14 m), MA-379(1); Caroline Cove (13 m), MA-311(1).

Comparative specimens examined. See O'Loughlin and O'Hara (1990).

Description of material. R = 15–75 mm, r to 13 mm; 5 subcylindrical arms, sometimes shed at base; disc small, disc skeleton reticulate. Abactinal spinelets spaced in small specimens (R < 40 mm) or grouped in large specimens, cylindrical or capitate, l/w = 2–2.5. Carinal plates raised, quadrilobed, bearing 8 spinelets in a 'V'-shape. To 10 small, narrow dorsolateral plates transversely between carinals and superomarginals, 1–3 longitudinal linkages, up to 6 spinelets per plate, up to 20 spinelets between carinals and superomarginals. Superomarginals cruciform, proximal plates sometimes beaded, to 8 spinelets in 1–2 transverse rows, lower spinelets club-shaped. Inferomarginals usually forming actinolateral margin to arm, 3–4, sometimes 5, flattened, flaring, truncate spines. 2 actinal series on larger specimens, first to three/quarters R, second to quarter R, with 0–3 spines. Adambulacrals with 3, sometimes 4, spines, furrow spine rectangular and chisel-shaped, spines away from furrow truncate and flaring,. Two pairs of oral spines, adoral spines larger than adambulacral spines. Dense crossed pedicellariae on abactinal, marginal surfaces, to 3 times as numerous as spinelets. Small lanceolate straight pedicellariae abactinally, marginally, actinally and in furrow. Large incipiently felipedal pedicellariae marginally, actinally and in furrow, each valve with small notch on either side of the hooked tip, largest on disc interradial area. 2 series of large suckered tube feet.

Reproduction. Gonads long (to half R) with short lateral branches or tubercules arranged in 2–3 longitudinal rows, attached at the base of arm on the lower dorsolateral surface; sexes separate, eggs elongate, 0.5–1.0 mm long.

Colour. Tan (in alcohol).

Habitat. The AM Expedition specimens were found on *Codium* adjacent to a dense *Macrocystis* bed, and on a sponge/hydroid mat under a rock overhang.

Distribution. Macquarie Island (11–357 m); South Tasman Rise (620–1650 m).

Remarks. The two large specimens collected by divers on the 1977–1978 Australian Museum Expedition (MA-311, R = 70 mm; MA-379, R = 75 mm) differ from the *S. clarkailsa* types (R to 38 mm) in having grouped abactinal spinelets, more numerous spines and spinelets, a second row of actinal plates and no beading on the super-

omarginal plates. These features indicate that *S. clarkailsa* is more closely related to the subantarctic species *S. scalprifera* (Sladen, 1889) than to the Australian species *S. irregularis* H.L. Clark, 1928. *S. clarkailsa* is distinguishable from *S. scalprifera* by the density of crossed pedicellariae. This species has been recently collected from seamounts south of Tasmania (O'Hara, 1998b).

Anasterias Perrier

Anasterias Perrier, 1875: 81.—Fisher, 1930: 221.—Fisher, 1940: 231.—A.M. Clark, 1962: 93.

Sporasterias Perrier, 1894: 107.—Fisher, 1930: 239.

Calvasterias Perrier, 1875: 84.—Fisher, 1930: 225. [New synonymy]

Remarks. *Calvasterias* was distinguished from *Anasterias* by the increased calcification of the abactinal skeleton. However, this feature varies within and between different populations of species in both genera. *Calvasterias* includes four species: *C. asterinoides* Perrier, 1875 the type species, supposedly from the Falkland Islands, *C. stolidota* Sladen, 1889 from South America, *C. laevigatus* (Hutton, 1879b) and *C. suteri* de Loriol, 1894 from New Zealand. I have examined adult specimens from all four species (see under *A. directa* below) and find no significant difference between the skeletons of the last three species and the skeleton of pentamerous *Anasterias* specimens from South America (*A. antarctica*), Kerguelen (*A. rupicola*) and Macquarie Island (*A. directa*). The status of the type species is uncertain, as it is unclear as to whether the types were collected from Torres Strait, the Falkland Islands or the Auckland Islands, south of New Zealand (A.M. Clark, 1962: 93–4). The only other known specimens are also of uncertain origin (A.M. Clark, 1962). These specimens (BMNH 1844.5.29) are small (R=17–23 mm) with coarse overlapping skeleton ossicles, reduced papular areas and few carinal or dorsolateral spines. They are similar to some small spinous specimens of *C. laevigatus* and are possibly members of that species. The overlapping skeleton is probably an artefact of collection and preservation. There is no justification for the retention of two genera, *Calvasterias* being a junior synonym of *Anasterias* by page priority.

Anasterias directa Koehler

Plate 2f–h

Parastichaster directus Koehler, 1920: 97–101, pl. xx figs 8–11, pl. xxi figs 8–12, pl. xxiii figs 1, 2, pl. lxii fig. 2.—Rowe and Pawson, 1977: 342.

Sporasterias directa.—Fisher, 1930: 241.—Bennett, 1971, pls 34, 35, 56 fig. 2.

Anasterias directa.—A.M. Clark, 1962: 97, text-fig. 17c.—Simpson, 1982: 43–45, figs 5, 6.—McKnight, 1984: 143.

Sporasterias antarctica.—Koehler, 1920: 78–79, pl. xviii figs 1–4. [non *A. antarctica* (Lütken, 1857)].

Material examined. (Specimens marked * are typical of the "*antarctica*" form). Macquarie Island, 10 Oct 1913, Low tide, H. Hamilton, AM J3636(2 syntypes of *P. directus*, the syntypes Koehler labelled "C" and "D" were inadvertently destroyed in, 1939 - see Pawson and Rowe, 1977); H. Hamilton, 1913, identified by Koehler (1920) as *S. antarctica*, AM J3726(11*); Secluded Beach, 27 Nov 1989, NMV F77766(4), F77767(18*); Garden Cove, Dec 1959, NMV F45010(15), F76254(30*); 15 Dec 1959, F45012(11*); 20 Dec 1961, NMV F76256(1*); 1961, NMV F76252(2*); 31 Mar, 1962, NMV F76267(1); 12 Aug 1962, NMV F76264(4), F76249(40*); 11 Feb 1964, NMV F76263(4), F76253(3*); 16 Jun, 1967, NMV F76262(5); 18 Jun, 1967, NMV F76261(1*); 14 July, 1975, NMV F76266(1); 25 Nov 1989, NMV F76274(1*); 26 Nov 1989, NMV F76273(2); Buckles Bay, 28 Dec 1948, NMV F76248(1 juv*); 16 Jul 1949, NMV F76247(2 juv*); 9 Feb 1950, NMV F76244(1*); Feb 1950, NMV F76242(2*); 8 Dec 1962, NMV F76265(2); Dec 1966, NMV F76270(1 juv); 7 Dec 1986, NMV 76272(1*); Sandy Bay, 7 Feb 1962, NMV F76271(1 juv), F76251(3*); Green Gorge, 24 Jul 1962, NMV F76257(4*); Lusitania Bay, 25 Jul 1962, NMV F76250(4*); Hurd Point, 10 Jan 1962, NMV F76260(1*); Caroline Cove, 10 Jun, 1962, NMV F76258(6*); Aurora Point, 8–9 Feb 1962, NMV F76268(1); Bauer Bay, 8 Oct 1962, NMV F76255(3*); Hasselborough Bay, 19 Dec 1949, NMV F76241(1); Aerial Cove, 2 Dec 1949, NMV F76246(1 juv*); 26 Jan 1950, NMV F76245(4 juv*); 28 Nov 1989, NMV F77768(3), F77769(17*). AM 1977–1978 Expedition, Gorilla Head Rock (8–12 m), MA-142(2), MA-147(1*); Tottan Head, Goat Bay (14 m), MA-39(1), MA-371(1); Tern Rock Bay (7 m), MA-35(4); Garden Cove (1–10 m) MA-14(4), MA-127(4*), MA-359(1), MA-360(1); NE Buckles Bay (intertidal), MA-93(1); Sandy Bay (9 m), MA-224(1); Green Gorge (int-14 m), MA-245(1), MA-247(2), MA-253(8), MA-256(1*), MA-259(1*), MA-280(1*), MA-281(5*); Caroline Cove (8-13 m), MA-300(1*), MA-306(2*); Handspike Point (intertidal-0.5 m), MA-136(4*), MA-138(2); Aerial Cove (0.5 6 m), MA-46(3), MA-47(3), MA-50(3*), MA-83(6), MA-102(2*), MA-107(3), MA-108(4*), MA-109(1), MA-382(4), MA-383(2*), MA-384(1*), MA-386(1), MA-388(8); Anchor Rock (13–20 m), MA-89(1), MA-95(1).

Comparative material examined. A. antarctica (Lütken, 1857): Magellan Strait, Punta Arenas, coll. Schythe, ZMUC(holotype); Chile, Linao, 41°50′S, 73°34′W, BMNH 1975.11.12.6(1); Argentina, Puerto Deseado, identified by Bernasconi, BMNH 1961.7.27.18(1); Golfo RE Concavi, Isla Calburo, identified by Bernasconi, BMNH 1961.7.17.19(1); Magellan Strait,

Fortescue Bay, *Discovery* stn 724, 0–5 m, 16 Nov 1931, BMNH, 1948.3.16.657(10); Cape Horn, St Martins Cove, Ross Antarctic Expedition, BMNH, 1960.4.13.1–2(4). *A. minuta* Perrier, 1875: Falkland Islands, Stanley Harbour, BMNH 1960.5.17.19(1). *A. studeri* Perrier, 1891: Falkland Islands, *Discovery* stn WS91, 191–205 m, 8 Apr 1927, identified by Fisher (1940), BMNH 1948.3.16.662(10). *A. stolidota* (Sladen, 1889): South Chile, Messier Channel, *Challenger*, BMNH(holotype). *C. asterinoides* Perrier, 1875: Falkland Islands (or possibly Auckland Is - see A.M. Clark, 1962), Dr J. Robertson, BMNH 1844.5.29(4). *A. rupicola* Verrill, 1876: Kerguelen, Port Jeanne d'Arc, BANZARE collection 783, identified by A.M. Clark (1962), SAM K1512(62); Greenland Harbour, BANZARE stn 54, BMNH 1965.8.5.251-275(24); Rivett Arm, BANZARE stn 56a, BMNH 1965.8.5.276-281(6); Marion Island, De Villier, BMNH 1973.12.18.4-11(7); BMNH 1973.12.18.12-15(4); Cabbage Point, G. Branch, in *Macrocystis* beds, 12 m , AM J18135(1); Transvaal Cove, G. Branch, in *Macrocystis* beds, AM J18136(1). *A. suteri* (de Loriol, 1894): New Zealand, Lyttelton, Suter, BMNH 1905.1.25.2-3(2); Bodley Head, Oliver, Mortensen's Pacific Expedition, ZMUC(4); Banks Peninsula, Taylors Mistake, E Bennett, BMNH 1952.11.18.4(2); Stewart Island, BMNH 86.11.18.12(1); Snares Island, H.B. Fell, BMNH 1952.4.16.19(1); Campbell Island, Windlass Bay, 23 Jan 1980, AM J22902(2). *A. laevigata* (Hutton, 1879b): Auckland Island, Port Ross, 25 Nov 1914, Mortensen's Pacific Expedition, ZMUC(20); 26 Nov 1914(20); Figure 8 Island, 2 Dec 1914, Mortensen's Pacific Expedition, ZMUC(4); Carnley Harbour, Mortensen's Pacific Expedition, 29 Nov 1914(1); Masked Island, 30 Nov 1914, Mortensen's Pacific Expedition, ZMUC(1); Crozier Point, H.B. Fell, BMNH 1952.4.16.13(3); Tagua Bay, Dawbin, Nov 1943, BMNH 1952.11.18.3(1); Passage Inlet, Dawbin, 24 Jul, 1943, BMNH 1952.11.18.5-7(4); Laurie Harbour, *Discovery* Expedition, BMNH 1905.7.14.6-9(many); Campbell Island, 26 Jan 1980, AM J22906(2); Campbell Island, Filhol, donated Paris Museum 1877, ZMUC(1);

Description of material. R to 60 mm, r to 17 mm. Arms 5, dorsally convex, ventrally flat, widest at base, tapering gradually to a blunt tip. Single madreporite, third to half-way from centre to interradial margin, small, sometimes inconspicuous, often ringed by some spinelets. Anus inconspicuous, central. Arm furrows wide, 4 rows of suckered tube feet.

Dorsal surface covered in thick pustular skin, with clusters of papillae and scattered to clustered low spinelets. Abactinal skeleton reticulate. Abactinal spinelets capitate, sometimes truncate, upper half spiniferous; of various sizes, 0.3–0.8 mm dia, 1–2 times as high as wide. Spinelets largest, widest on disc and proximal arm surfaces. Carinal plates in irregular, often sinuous row; plates square, lobed, L-shaped or irregular in shape, imbricating. Spinelet distribution variable. Some specimens with regular transverse arcs of 3 spinelets on succeeding carinal plates, other specimens more irregular with 1–7, often 1, spinelet on each plate. Up to 7 dorsolateral plates linking carinals and superomarginals in irregular transverse rows, sometimes in regular rows or completely reticulate; plates bar-like or irregular; 1–3 longitudinal linkages proximally, sometimes forming longitudinal rows. 0–1, rarely 2, spinelets on dorsolateral plates, up to 6 present in total between carinals and superomarginals.

Papular areas with clusters of 4–5 papulae in centre, often forming regular longitudinal rows on either side of superomarginal plates, otherwise areas scattered amongst the reticulate skeleton. 1–2 actinal papulae are present between inferomarginal plates.

Superomarginal plates longer than wide, 4-lobed, long ventral lobe, shorter dorsal and lateral lobes, dorsal lobe often not transversely aligned with ventral lobe but displaced toward arm tip, plates imbricate with surrounding dorsolateral, superomarginal, inferomarginal plates. Superomarginal spinelets to 1.0 mm in height, 2–2.5 times as high as wide, 1–3 on each plate, 1–2 spinelets near dorsal lobe, 0–1 smaller spinelets on ventral lobe, rarely some additional very small spinelets, dorsal spinelets form regular longitudinal rows extending from disc to arm tip, ventral spinelets sometimes form a less regular and less extensive row. Inferomarginal plates form an actinolateral margin to arm, wider than long, 4-lobed, dorsal and ventral lobes shorter than lateral lobes, prominent oblique spine-ridge present centrally. Inferomarginal spines thick, capitate, slightly curved, terminally spiniferous, 2–3, rarely 4, per plate, 2.5 mm high, 3–4 times as high as wide, aligned obliquely. Actinal plates bar-like, wider than long, extend almost to arm tip, sometimes 2 series proximally, usually aligned with inferomarginals. Actinal spines, usually 1 per plate, sometimes 2 on proximal plates aligned transversely, often confluent with, but smaller than inferomarginal spines, on larger specimens spine persists to arm tip. 8–10 adambulacral plates to every 3 inferomarginals. Adambulacral spines, one per plate, thinner than inferomarginal spines, 2.5 mm high, 3–5 times as high as wide. On each jaw 2 small oral spines, 2 larger suboral spines, larger than nearest adambulacral spines.

Straight pedicellariae present in arm furrows and on jaw, valves with rounded tips, no teeth; distribution variable, numerous to scarce. Crossed pedicellariae present on dorsal side of inferomarginals, near superomarginals and on lower abactinal surface.

Reproduction (from Simpson, 1982). Separate sexes. Females brood their young from egg to juvenile stage as a cluster under the disc. Eggs are transferred to the brood in July and juveniles are released in October–November. Females adopt an arched posture to hold the brood.

Colour (live). Dorsal surface dark olive green or green brown, sometimes mottled at arm tip, spinelets pale, madreporite white. Ventral surface white, tube feet and tips of adambulacral spines tan. Juveniles pink or orange, egg mass orange.

Habitat. Shore collectors have found this species in sheltered and exposed sites, including intertidal rock pools, rock gutters and boulders, and amongst *Durvillaea* holdfasts. Divers (to 20 m) have also found it on sheltered and exposed rock surfaces, and amongst *Macrocystis* beds. McKnight (1984) has reported one dredged specimen from 55 m.

Distribution. Macquarie Island (0–55 m).

Remarks. The genus *Anasterias* presents considerable difficulties for taxonomists. Many of the nominal species are very variable and ill-defined. There have been many disagreements about synonymies, particularly regarding Magellanic and Falkland Islands species (Fisher, 1940; A.M. Clark, 1962; A.M. Clark and Downey, 1992). Macquarie Island specimens are also very variable in many characters. These include the shape, density and distribution of abactinal spinelets; the rigidity and regularity of the abactinal skeleton; the nature of the abactinal integument, the number of inferomarginal spinelets; and the distribution of the various pedicellariae. Some characters such as the shape of the arm, the density of the skeletal plates and the pustular nature of the skin can vary with preservation. Many of the characters are difficult to quantify and do not lend themselves to traditional morphological analysis.

Koehler (1920) recognised two five-armed species from Macquarie Island: *Sporasterias antarctica* (Lütken, 1857) and *Parastichaster directus* Koehler, 1920. Koehler (1920) did not directly compare the two species, but the understanding of the two genera at that time, indicates that they differed in the regularity of the abactinal skeleton and the density of the abactinal spinelets. Fisher (1923, 1930, 1940) subsequently synonymised the genera *Sporasterias* Perrier, 1894 and *Parastichaster* Koehler, 1920 with *Anasterias*, noting the continuous variation in these features. All subsequent five-armed specimens collected from Macquarie Island have been referred to the species *A. directa.*

Two morphological extremes are recognisable in the current large range of specimens that correspond to Koehler's "species". One form ("*antarctica*") has an irregular abactinal skeleton; a sinuous, irregular carinal series; and 1–2, occasionally 3, carinal spinelets on each plate (pl. 2h). These specimens are broadly similar to the 11 extant specimens of *S. antarctica* identified by Koehler (AM J3726). The other extreme ("*directa*") has a more regular, strongly built dorsolateral skeleton, often with regular longitudinal rows of plates and spinelets (pl. 2g). The carinal plates usually bear three spinelets in a transverse arc, although plates with one or two spines are not rare and other plates can have as many as seven. These features are observable in specimens as small as R = 2 mm. This form is similar to the two extant syntypes of *P. directus.* However, between these extremes there are many variations. Carinal plates with three spinelets can be present on specimens with an irregular skeleton. Sometimes the arrangement of carinal spines can vary on the same animal. Moreover, as listed earlier, many other features vary in a similar fashion in both forms. There is no consistently observable morphological characteristic that can be used to satisfactorily separate the two forms.

Similar morphological differences exist within material from the Magellanic region and from the subantarctic Islands of New Zealand. The extremes have been generally distinguished as species. In the South American region, strongly calcified specimens have been distinguished as *Calvasterias stolidota* Sladen, 1889 or *A. varia* Philippi, 1870 from the more common *A. antarctica.* A further form with a very weakly calcified skeleton, represented in South America by *A. minuta* Perrier, 1875, does not appear to exist at Macquarie Island. A.M. Clark and Downey (1992) have noted the variability of all the Magellanic forms and record only *A. antarctica* as representative of the group. Of the numerous nominal species of *Anasterias* from South America, only *A. studeri* appears to be readily distinguishable from *A. antarctica,* having numerous long abactinal spinelets, triangular straight pedicellariae, and a preference for deep water (< 100 m) habitats (Fisher, 1940; A.M. Clark, 1962; A.M. Clark and Downey, 1992). *A. antarctica* is recorded as being dark green in colour when alive (Madsen, 1955) and broods its young in the typical arched posture. Specimens I have examined have relatively few carinal and dorsolateral spinelets and many specimens, unlike my Macquarie material, have numerous crossed pedicellariae on the marginal and abactinal surfaces.

In the subantarctic Islands of New Zealand, two species are recognised: *A. suteri* with a regular, strongly calcified skeleton and *A. laevigata* with a more weakly calcified skeleton. *A. laevigata* is similar to the Macquarie Island "*antarctica*" form. Mortensen (1925) describes the abactinal spination as being very variable, some animals have an irregular single row of carinal spines and 1–2 irregular dorsolateral rows, others have no carinal or dorsolateral spines at all, rarely a specimen can have 2–3 carinal spines. This variation is also present in some of the specimens I have examined. The distribution of pedicellariae is also very variable. Some specimens have numerous crossed pedicellariae abactinally while others have numbers of straight pedicellariae. Colour is reported as dark green or grey-green with fawn arm tips for adults, and orange for juveniles (H.B. Fell, 1953). Brood juveniles are found between August and November (H.B. Fell, 1953). *A. suteri* on the other hand is clearly distinct having a dense cluster of 4–8 spinelets on each carinal plate. There is one, rarely two, longitudinal rows of dorsolateral spines and 1–2 spines on the superomarginal plates. The colour is fawn-brown or grey-green; brood juveniles have been found in October (H.B. Fell, 1953).

At Kerguelen and Marion Islands, only one five-armed form is recognised: *A. rupicola* Verrill, 1876, which has an irregular abactinal skeleton. No five-armed *Anasterias* species have been found at Heard Island. Specimens of *A. rupicola* from Kerguelen are indistinguishable from the "*antarctica*" specimens from Macquarie Island. Specimens I have examined measure R=9–40 mm and have a sinuous carinal series with 1–3 spinelets. Sometimes carinal spinelets can be arranged in a transverse arc of three spines on at least part of an arm, however, none approach the regular arrangement of the "*directa*" specimens from Macquarie Island. They have up to six dorsolateral spines between the carinals and superomarginals, 1–2 spines on the superomarginal dorsal lobe and one on the ventral lobe, 2–4, usually three, inferomarginal spines and one actinal spine. Two specimens collected in February are arched with traces of brood juveniles around the mouth.

Specimens of *A. rupicola* from Marion Island appear to have relatively few spines. Specimens I have examined have a single carinal spine, 2–3 dorsolateral spines between the carinals and superomarginals, 1–2 superomarginal and 2–3 inferomarginal spines. Bernasconi (1971) recorded numerous "thick" abactinal spines from his Marion Island specimens, including 3–4 dorsolateral spines transversely. The carinal "lines" were scarcely visible. Live colour is green or orange (Branch et al., 1993). Females start brooding eggs in June to August, young are released in December–January although remnant young continue to be present as late as March; relatively few females brood within a population (Blankley and Branch, 1984).

The two forms from Macquarie Island could represent two closely related perhaps hybridising species or one polymorphic species. However, there appears to be no obvious geographic, bathymetric or ecological premating reproductive isolating mechanism now operating to separate the two forms at Macquarie Island. There is an abundance of morphological intermediates. The two forms have been regularly found from similar sites at the same location. Their reproductive cycles are similar. In the absence of a clear morphological distinction, and without molecular evidence to the contrary, I am referring all the five-armed Macquarie Island *Anasterias* specimens to the single polymorphic species: *A. directa*. Given this interpretation, this species differs from *A. antarctica, A. rupicola* and *A. laevigata* by the greater range of variation expressed in the number and distribution of spinelets and the restricted range of variation in the abundance of abactinal pedicellariae. Probably *A. directa, A. rupicola* and *A. laevigata* should only be regarded as infraspecific regional forms of *A. antarctica*. It is clear that traditional morphological characters are insufficient to properly differentiate the various taxa in this genus.

Anasterias mawsoni (Koehler)

Plate 2i–k

Stichaster suteri.—Benham, 1909: 32 [non *Calvasterias suteri* de Loriol, 1894].

Parastichaster mawsoni Koehler, 1920: 91–97, pl. xix figs 1–8, pl. xx fig. 1, pl. xxi figs 1–6, pl. xxiii fig. 4, pl. xxiv fig. 5, pl. xxx fig. 5, pl. lxiii fig. 2.—Rowe and Pawson, 1977: 345.

Parastichaster sphoerulatus Koehler, 1920: 101–105, pl. xxi fig. 7, pl. xxiii figs 5–10, pl. xxiv figs 1–4, pl. lxiii fig. 3, pl. lxiv figs 1, 2.—Rowe and Pawson, 1977: 347. [new synonymy]

Sporasterias mawsoni.—Fisher, 1930: 241.—Bennett, 1971, pl. 56 fig. 1.

Sporasterias sphoerulata.—Fisher, 1930: 241.—Bennett, 1971, pl. 56 fig. 2.

Anasterias mawsoni.—A.M. Clark, 1962: 96.—Simpson, 1982: 41–43, figs 3, 4.—McKnight, 1984: 143.

Anasterias sphoerulata.—A.M. Clark, 1962: 96–97.—McKnight, 1984: 143.

Material examined. (Specimens marked * are typical of the "*sphoerulata*" form). Macquarie Island, 10 Oct

1913, AM J3638(4 syntypes of *P. mawsoni*); Oct 1913, AM J3637(2 syntypes of *P. sphoerulatus*); Secluded Beach, 19 Jan 1965, NMV F76177(1); 27 Nov 1989, NMV F76186(7*); Garden Cove, 7 May 1949, NMV F76169(1); Dec 1959, NMV F45009(4 and brood); 15 Dec 1960, NMV F45013(1*); 13 Jul 1962, NMV F76171(1*); 12 Aug 1962, NMV F76175(1), NMV F45109(1); 11 Feb 1964, NMV F76188(2); 18 Jun 1967, NMV F76176(3); 25 Nov 1989, NMV F76184(5*); 26 Nov 1989, NMV F76185(1*); Buckles Bay, 28 Dec 1948, NMV F76165(2); 16 Jul 1949, NMV F76130(2), NMV F76164(2), NMV 76162(1); 9 Feb 1950, NMV F76168(1), NMV F76181(2*); 9 Feb 1952, NMV F76161(2); 8 Dec 1962, NMV F76170(7); 7 Dec 1986, NMV F76180(1); Hasselborough Bay, 31 Mar 1950, NMV F76182(1*); Aerial Cove, 28 Nov 1989, NMV76187(6). AM 1977–1978 Expedition, Gorilla Head Rock (9–12 m), MA-142(2), MA-145(1), MA-146(5), MA-148(1), MA-149(11); Tottan Head, Goat Bay (9–14 m), MA-39(1), MA-42(4*), MA-369(1), MA-371(5), MA-374(5), MA-375(6), MA-376(2 and brood); Tern Rock Bay (7–10 m), MA-35(5*), MA-37(2); Garden Cove (8–14 m) MA-14(11*), MA-15(1*), MA-87(1*), MA-91(1), MA-123(1), MA-124(1), MA-125(2*), MA-127(7), MA-128(6*), MA-379(4); Sandy Bay (9 m), MA-224(1*); Green Gorge (6–18 m), MA-245(4), MA-247(6), MA-250(1), MA-251(2), MA-269(1), MA-275(1), MA-291(2); Caroline Cove (8–13 m), MA-298(2), MA-300(1), MA-306(2), MA-311(8); Aerial Cove (0.5–6 m), MA-46(4), MA-47(20), MA-50(3), MA-56(1), MA-83(8), MA-98(2), MA-100(3), MA-102(6), MA-107(12*), MA-108(7), MA-109(5 and brood), MA-110(5), MA-382(>24), MA-383(2), MA-386(17), MA-388(7), MA-389(4); Anchor Rock (13–20 m), MA-89(3*), MA-90(6*).

Heard Island, Atlas Cove, shore, 28 Dec 1929, BANZARE stn, 19, identified by A.M. Clark (1962) as *A. sphoerulatus*, SAM K1515(2*); 19 May 1949, NMV F76125(1); 11 Sep, 1949, NMV F76127(1 juv); 16 Jan 1950, 30 m, NMV F76124(2); 3 Jul 1950, NMV F76129(9 juv); 16 Aug 1950, NMV F73886(11); 19 Dec 1951, NMV F76128(1); 28 Jan 1952, NMV F76179(1); 8 Feb 1952, NMV F76126(1).

Comparative specimens examined. A. perrieri (Smith, 1876): Kerguelen, Bras Bossiere, 4 m, BANZARE stn 7, SAM K1497(12); BANZARE collection 712, 9 m, 10 Nov 1930, SAM K1508(1).

Description of Macquarie Island material. R to 62 mm, r to 15 mm. Arms 6, dorsally convex, ventrally flat, widest at base, tapering gradually to a blunt tip. Single madreporite, half to two-thirds from centre to interradial margin, small to large, sometimes inconspicuous, sometimes ringed by some spinelets. Anus inconspicuous, central. Arm furrows wide, 4 rows of suckered tube feet.

Dorsal skin thick and pustulate. Abactinal skeleton reticulate. Spinelets capitate, sometimes truncate, upper half spiniferous; often polygonal in cross section if in contact with adjacent spinelets; size variable, 0.4–1.1 mm dia, 1–2 times as high as wide; spinelets largest, widest on disc and proximal arm surfaces. Spinelets arranged in rows around aboard papular areas.

Carinal plates form recognisable longitudinal row down arm; plates irregularly quadrilobed or rhombic, broadly imbricating. Spinelets distribution variable, from being densely clustered on plates, with up to 13 spinelets in 5 longitudinal rows, to scattered with as few as 2–4 discrete spinelets. Dorsolateral skeleton variable, from strongly calcified with block-like imbricating plates to weakly calcified with thin bar-like or trilobed plates; forming transverse rows of up to 7 plates between carinals and superomarginals; forming 1–3 longitudinal rows, the row nearest the carinals most distinct; sometimes reticulate proximally. Dorsolateral plates with 0–3, usually 1–2, spinelets on raised section of plate; forming uni- or biserial rows transversely, with up to 12 spinelets present between carinals and superomarginals, forming irregular rows longitudinally.

Papular areas with clusters of 4–8 papulae, single actinal papulae present between inferomarginal plates.

Superomarginal plates from as long as to longer than wide, irregularly quadrilobed, long ventral lobe, shorter dorsal and lateral lobes, plates imbricate with surrounding plates. Superomarginal spinelets to 1.0 mm in height, 2–2.5 times as high as wide, 2–7, usually 2–3, per plate. Inferomarginal plates forming actinolateral margin to arm, as wide as long, lobed, prominent oblique spine-ridge present centrally. Inferomarginal spines thick, capitate, slightly curved and terminally spiniferous or occasionally flattened and flared; 2–5, usually 3–4, per plate, 2.5 mm high, 2.5–4 times as high as wide. Actinal plates bar-like, wider than long, extend past half R, sometimes 2 series proximally, usually aligned with inferomarginals, with one spine, often confluent with, but smaller than inferomarginal spines. 6 adambulacral plates to every 2 inferomarginals. One adambulacral spine per plate, thinner, smaller than inferomarginal spines, 2.5 mm high, 4–5 times as high as wide, often club-shaped. On each jaw 2 oral and 2 suboral spines; oral spines often short.

Straight pedicellariae present near mouth, in disc interradius, in arm furrows and amongst inferomarginals; size and distribution variable, sometime very numerous or scarce; some valves widened and truncate at tip; minority (typically 10 %) 3-valved, with additional small valve present at right angles to 2 primary valves. Crossed pedicellariae present marginally and dorsally, sometimes in high numbers.

Reproduction. Macquarie Island population with separate sexes. Females brood juveniles under their discs by adopting an arching posture. Broods with up to 296 juveniles. Eggs mature in gonad from July to December until the eggs reach 2.0 mm diameter. Eggs are usually transferred to the brood in January–Febuary and released in May–June (Simpson, 1982). Two specimens in the present collection have brood juveniles in December and January.

Colour. Live Macquarie Island specimens orange, tan, dark brown, purple or green on dorsal surface; spinelets and papulae often paler or different colour; dark stomach caeca visible beneath skin on smaller specimens. Ventral surface cream or white, spines pink or grey, tube feet tan.

Habitat. Present on rock platforms under boulders, or in rock gutters, and subtidally (2–20 m) on sheltered sponges-bryozoan mats, on *Codium*, or under *Macrocystis*. McKnight (1984) reported several dredged specimens from 357 m.

Distribution. Heard Island (0–30 m); Macquarie Island (0–357 m).

Remarks. The six-armed Macquarie Island specimens of *Anasterias* are as variable as the five-armed specimens described above under *A. directa*. The dorsal skeleton varies from being strongly calcified, with block-like plates and a dense covering of polygonal spinelets (pl. 2k), to a more open structure with thin bar-like plates and relatively few discrete rounded spinelets (pl. 2j). The former specimens were described by Koehler (1920) as *P. sphoerulatus* and the latter as *P. mawsoni*. However, there are numerous intergrades between these extremes. Koehler's other distinguishing character for *A. sphoerulatus*, the unusual three-valved pedicellariae, are present on most specimens. The different colour forms do not correlate with skeletal structure or spinelet density. Consequently, I refer *A. sphoerulatus* to the synonymy of *A. mawsoni*.

This species is also common from the littoral of Heard Island. Heard Island specimens show a similar range of variation in the skeleton and spinelets. They also have some three-valved pedicellariae. A.M. Clark (1962) noted the reduced actinal series on BANZARE specimens from Heard Island. This is also a variable feature. Several specimens from Heard Island (NMV F73886) have a well developed primary actinal series extending to the arm tip, and a second series proximally.

The only other six-armed *Anasterias* species is *A. perrieri* (Smith, 1876) from Kerguelen. This species appears to occupy a similar ecological niche at Kerguelen (McClintock, 1985) as *A. mawsoni* at Macquarie Island, but it differs from *A. mawsoni* in having thinner and less numerous spinelets. Specimens of *A. perrieri* that I have examined have no three-valved pedicellariae.

A. mawsoni is not merely a six-armed form of *A. directa*. Besides the differing number of arms, the two species differ in the density of the abactinal spinelets, the colour, and the absence in *A. directa* of three-valved pedicellariae. There is also a time difference of four months between the peak release of brooded young for each species (Simpson, 1982).

Class Ophiuroidea

Key to Macquarie Island Ophiuroidea

1. Disc and arms covered in thick skin concealing any underlying plates or scales unless dried. Arms cylindrical in cross section. Oral papillae and teeth expanded with glassy toothed margin ..... *Ophiomyxa* sp.[a]
— Disc and arms not obscured by skin, although cover of spines may be present. Arms somewhat flattened in cross section 2
2. 2 squarish papillae at apex of each jaw 3
— 1 papilla at apex of each jaw (occasionally an additional oral papillae apical in position, but never 2 squarish papillae) 5
3. 2 low oral papillae on side of each jaw in addition to apical ones, distalmost papilla 2–3 times as long as proximal one ..... *Amphipholis squamata*[b]
— 1 distal oral papilla on each side of jaw, separated from apical one by wide gap 4
4. 6–7 arm spines, lowermost spine considerably longer than the upper spines. Ventral disc surface covered in scales ..... *Amphiura magellanica*
— 4 subequal arm spines. Ventral disc surface naked near oral shields ..... *Amphiura* cf. *angularis*[c]
5. Arms inserted laterally into disc and firmly fused to it. No disc spines 6
— Arms inserted ventrally under the disk, disk margin overlying base of arm .. 9

6. Dorsal arm plates fragmented into 2 lateral plates and several smaller pieces in between. No arm comb ..... *Ophioplocus incipiens*
— Dorsal arm plates entire. Arm comb present 7
7. Disc covered by large circular scales surrounded by smaller plates. 3 minute arm spines, difficult to see ..... *Ophiurolepis inornata*[d]
— Not as above 8
8. Distal arm spines with upturned hook-like ends. Small accessory plates lateral to each proximal ventral arm plate .... *Ophiura (Ophiuroglypha) irrorata*
— Arm spines simple and pointed. No accessory ventral arm plates ....*Ophiura (Ophiura) meridionalis*
9. Dorsal disc plates bordered by rows of spherical granules. Disc margin bordered by row of elongate granules. Arms very slender .... *Ophioleuce regulare*
— Disc plates naked or with spines, never with granules 10
10. Apical jaw papillae wider than long, rectangular or tricuspid. 6 arms. Asexually reproduces though fission ..... *Ophiactis hirta*
— Apical papillae longer than wide, usually pointed. 5 arms 11
11. Disc stumps large, cylindrical or club shaped, regularly covered by rows of tiny sharp thorns. Radial shields as wide or wider than long, not covered in plates or stumps ..... *Ophiomitrella conferta*[e]
— Disk spines small, irregular or conical with terminal thorns. Bar-like radial shields largely concealed by disc plates and spines (distalmost end may be exposed) 12
12. Distalmost oral papilla widened. Tentacle scales half the size of the ventral arm plate ..... *Ophiacantha sollicita*[f]
— Oral papillae subequal or proximal papilla slightly enlarged. Tentacle scale almost as long as ventral arm plate ..... *Ophiacantha vilis*

Notes on key:

[a] McKnight (1984: 144) recorded two specimens of an undetermined *Ophiomyxa* species from Macquarie Island (183 -415 m). As McKnight pointed out, they share several characteristics of *O. brevirima* H.L Clark, 1915 from New Zealand, including alternating arm spines. On one 7 mm d.d. specimen I have examined (NZOI stn D6, 55°27′S, 158°31.5′E, 415 m), a large rounded upper arm spine is present on some arm segments in addition to the 2 smaller spines. However, unlike *O. brevirima* the dorsal arm plates are entire, bell-shaped and contiguous. The material is not adequate for a complete description.

[b] McKnight (1984: 144) recorded one specimen of the cosmopolitan species *A. squamata* (Della Chiaje, 1828) from Macquarie Island (155 m).

[c] Two specimens of *A. angularis* Lyman, 1879 were recorded by McKnight (1984: 144) from Macquarie Island (NZOI stn D6, 55°27′S, 158°31.5′E, 415 m). I have examined several specimens and they broadly match Lyman's (1882) description and figures (pp. 134–135, pl. XXIX figs 1–3) except that they lack tentacle scales. The disc is naked near the oral shields and orange gonads are visible underneath. They are much smaller (2 mm d.d.) than Lyman's holotype (9 mm d.d.) and the lack of tentacle scales may be a juvenile character or an artefact of preservation. Without a good growth series they cannot be positively identified. *A. angularis* has been recorded from Kerguelen, Heard, Marion Islands, South Africa and New Zealand. However, not all these populations appear conspecific. Mortensen (1936) noted that specimens from South Africa and Kerguelen are scaled on the ventral side of the disc. Branch et al. (1993) have figured a specimen with very long arms. A thorough review is required.

[d] McKnight (1984: 145) recorded one specimen of the widespread deep-water species *O. inornata* (Lyman, 1878) from the south of Macquarie Island (NZOI stn D5, 56°40.6′S, 158°45.5′E, 1280 m).

[e] McKnight (1984: 144) recorded 3 specimens of *O. conferta* (Koehler, 1922b) from the northern Macquarie Ridge (NZOI stn D159, 49°01′S, 164°50′E, 741 m). O'Hara (1990: 299) has recorded this species from off southeastern Australia, Antarctica and the Magellanic region from 40–2340 m.

[f] McKnight (1984: 144) has recorded 28 specimens of *O. sollicita* Koehler, 1922b from two NZOI stations on the northern Macquarie Ridge (NZOI stns D17 and D18, 52°31′S, 160°31′E, 124–128 m). The specimens from NZOI stn D17 have apparently disintegrated (P. Anderson, pers. comm.). Three specimens from stn D18 were examined and compared to the syntypes

from off eastern Tasmania. The Macquarie Island specimens differ in having slightly smaller disc spines (to 0.1 mm, compared to 0.15 mm for the syntypes) which are absent ventrally, and wider ventral arm plates. More material is required to determine if the Macquarie Island specimens represent a distinct species. *O. brachygnatha* H.L. Clark, 1928 from off south-eastern Australia and New Zealand is also similar but has much thinner, moniliform arms and smaller disc spines. O'Hara (1990: 295–296) noted the similarity of *O. sollicita* with the other nominal species from the Atlantic.

Order Ophiurida

Ophiacanthidae

Ophiacantha vilis Mortensen

Plate 3a–c, Figure 4

Ophiacantha vilis Mortensen, 1924: 114–7, fig. 7.—H.B. Fell, 1952: 14.—H.B. Fell, 1958: 25.—McKnight, 1967: 308.

Ophiacantha pentagona.—Madsen, 1967: 59.—McKnight, 1984: 144. [non *O. pentagona* Koehler, 1897]

Material examined. Macquarie Island, off Lusitania Bay, 54°42.5′S, 158°54.5′E, 69 m, 5 Dec 1930, BANZARE stn 83, SAM K947(1). AM 1977–1978 Expedition, Tottan Head, Goat Bay (14 m), MA-371 AM J22265(3), MA-376 AM J22266(1) and AM J22267(6); Garden Cove (10–14 m), MA-123 AM J22258(1), MA-124 AM J22262(1), MA-127 AM J22259(1) and AM J22260(4), MA-128 AM J22261(1), MA-379 AM J22263(1) and AM J22264(4); Buckles Bay (15 m), MA-141 AM J22269(1); Caroline Cove (8 m), MA-300 AM J22268(1); Aerial Cove (6 m), MA-388 AM J22270(1). ANARE 1986 Expedition, BT3 NMV F60293(1), BT10 NMV F60292(1).

New Zealand, Cook Strait, 372 m, 13 Aug 1920, ZMUC(syntype).

Comparative specimens examined. O. imago Lyman, 1878: Kerguelen, Christmas Harbour, 220 m, *Challenger*, BMNH 1882.12.23.318(holotype).

Description of Macquarie Island material. Disc 1–7 mm d.d., arms to > 20 mm. Disc covered in thin imbricating scales, usually bearing 1 small conical or cylindrical stump with 4–8 terminal thorns. Radial shields concealed. Ventral disc stumps smaller, less numerous towards oral shields. Oral shields trapezoid, wider than long, distal lobe often slightly produced. Adoral shields long, narrow, slightly curved, meeting interradially, separated radially. Apical papilla leaf-like, pointed, or irregularly widened on larger specimens; 3, rarely 4, oral papillae, innermost largest, flattened, leaf-like, outer papillae cylindrical, blunt. Dorsal arm plates triangular with convex distal edge, proximal plates just contiguous on larger specimens, other plates separate. Second ventral arm plate triangular, other plates roughly pentagonal with convex notched distal edge, proximal plates wider than long, plates separate throughout. 6, rarely 5 or 7, thick, often finely serrated, bluntly pointed arm spines, uppermost spine longest, on proximal plates enlarged to 1.5 times length of second spine, almost meeting over dorsal midline, lower spines progressively shorter, thinner. Tentacle scale large, almost as long as ventral arm plate, flat, oval or truncate, sometimes terminally thorny.

Reproduction. Viviparous, two specimens (5 mm d.d, NMV F60292; 5.5 mm d.d., AM J22262) with a juvenile in several bursae, other specimens with large orange eggs.

Colour. Dorsal disc and arm surfaces brown or tan, paler ventrally, white arm spines (in alcohol).

Habitat. Diver-collected specimens from Macquarie Island have been found on rocks amongst sponges, red algae, bryozoans and hydroids; one specimen was found on coarse sand.

Distribution. Macquarie Island (6–433 m); New Zealand (90–1090 m); Chatham Rise (241–251 m).

Remarks. Close examination of the Macquarie Island specimens has revealed that they are closer in form to *O. vilis* of New Zealand rather than the Indo-Pacific species, *O. pentagona*, to which they have been previously referred. *O. pentagona* (as described and figured by Koehler 1897 and, 1922a) has minute tentacle scales and slender disc spines with 3–4 long sharp terminal thorns (Koehler, 1922a, pl. 93, fig. 5). In contrast, comparison of a syntype of *O. vilis* (4 mm d.d.) with Macquarie Island specimens of similar size, revealed no significant morphological differences. The syntype of *O. vilis* closely agrees with Mortensen's (1924) description and figures, except that the radial shields are widely separated and disc spines relatively larger than shown on the figures. Photographs of the syntype are reproduced here (pl. 3b, c). The tentacle scales are large, often as long as, or longer than, the ventral arm plate; there are 6–7 finely serrated proximal arm spines and the disc spines are short stumps with 3–4 terminal thorns. There is much variation in the shape of the oral shields in the Macquarie material, particularly in the degree of prominence of the distal lobe. H.B. Fell (1952) has reported a similar variation in New Zealand specimens.

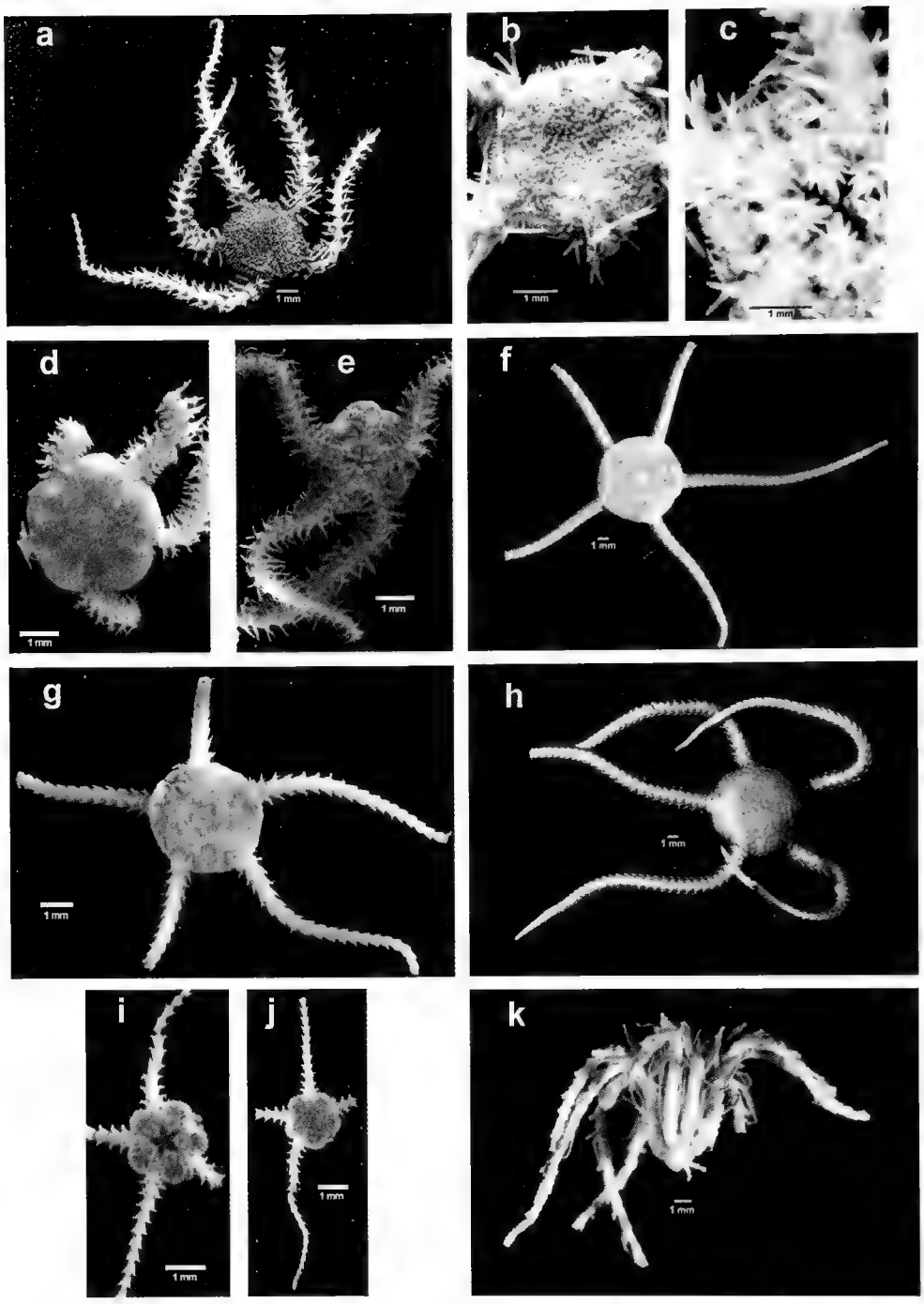

Plate 3. a, *Ophiacantha vilis*, dorsal view, NMV F60293; b, *Ophiacantha vilis*, syntype, dorsal view of disc, ZMUC; c, *Ophiacantha vilis*, syntype, oral view of disc, ZMUC; d, *Amphiura magellanica*, dorsal view (several arms broken), NMV F60294; e, *Amphiura magellanica*, ventral view (one arm missing), NMV F60294; f, *Ophiura irrorata*, dorsal view (arm tips broken), NMV F60298; g, *Ophiura meridionalis*, dorsal view of arm (arm tips broken), NMV F60297; h, *Ophioplocus incipiens*, dorsal view, NMV F60299; i, *Ophioleuce regulare*, ventral view (arm missing from upper right), NMV F60314; j, *Ophioleuce regulare*, dorsal view (arm missing from lower right), NMV F60314; k, *Florometra austini*, lateral view (several arms broken, most cirri lost), NMV F60300.

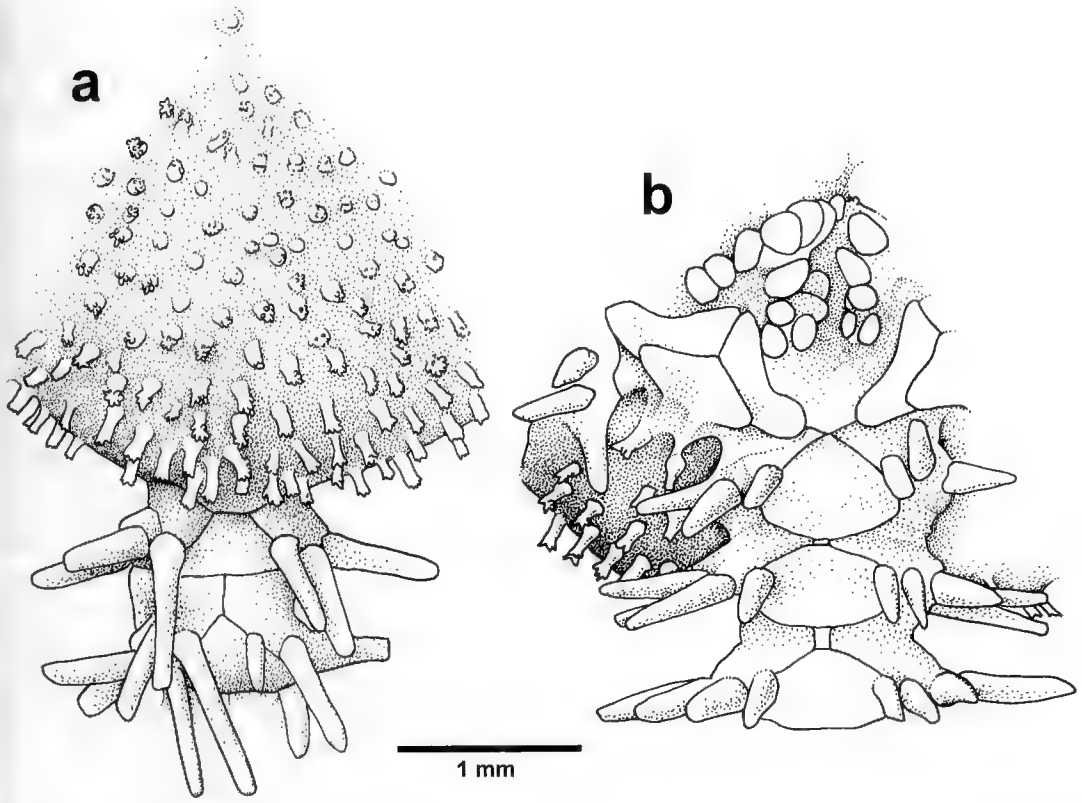

Figure 4. a–b, *Ophiacantha vilis*, NMV F60292: a, dorsal view of base of an arm and adjoining disc; b, ventral view of arm base and adjoining jaws.

There are, however, differences in the reported size, bathymetric distribution and reproductive behaviour between the Macquarie Island and New Zealand specimens. The Macquarie Island specimens grow to 7 mm d.d., while the largest reported New Zealand specimen is 4 mm d.d.. Several obvious growth changes occur in the Macquarie Island specimens. Most notable is the change in disc spines which are relatively shorter, wider and with more thorns on large specimens. Future research may find detectable differences between Macquarie Island and larger New Zealand specimens. The Macquarie Island form is common in the upper subtidal zone (in fact it is the only ophiuroid known above 20 m depth), while the New Zealand form has only been collected below 100 m. This species could prefer the colder water which surrounds Macquarie Island. Finally, the Macquarie Island specimens are viviparous, while H.B. Fell (1958) states that the New Zealand specimens are not. This again could be due to the small size of the New Zealand material. None of the present Macquarie Island specimens under 5 mm d.d. show signs of viviparity. Further evidence is needed to determine if the two populations should be separated into distinct specific or subspecific taxa.

Another similar species, *O. imago* Lyman, 1878, has been recorded from Kerguelen, Marion Island and New Zealand. Examination of the holotype of that species (7 mm d.d.) revealed that it differs from the Macquarie Island specimens in having minute tentacle scales, widely separated dorsal arm plates proximally, longer arm spines, to 3 mm long, and conspicuously thorny distal arm spines. Otherwise it is very similar to the Macquarie Island specimens, particularly in the shape of the disc spines, and it is also viviparous. It agrees closely with Lyman's (1882) description and figures. Whether all the New Zealand specimens referred to *O. imago* belong to that species needs close examination. *O. imago* has not been satisfactory separated from *O. pentagona* and both share the same minute tentacle scale and arm spine number. Very little data on the New Zealand specimens has been published.

Amphiuridae

Amphiura magellanica Ljungman

Plate 3d–e

Amphiura magellanica Ljungman, 1867: 320.—Mortensen, 1924: 132, figs 14, 15a.—Madsen, 1967: 129.—McKnight, 1984: 144 [limited synonymy].

Material examined. Macquarie Island, off Buckles Bay, 54°30′S, 158°58′E, 15 m, 19 Oct 1983, NMV F82954(4); off Lusitania Bay, 54°42.5′S, 158°54.5′E, 69 m, 5 Dec 1930, BANZARE stn 83, SAM K1038(4). ANARE 1986 Expedition, BT2, NMV F76112(1); BT3, NMV F60294(2); BT4, NMV F76222(3); BT5, NMV F60295(1); BT7, NMV F76111(7); BT8, NMV F60296(2).

South America, Tierra del Fuego, *Discovery* stn 1321, identified by Mortensen (1936), BMNH 1936.12.30.531–540(10). Gough Island, *Discovery* stn 399, BMNH 1936.12.30.521–530(12). Auckland Island, Tagua Bay, identified by H.B. Fell (1953), BMNH 1952.11.18.31–32(6).

Comparative material examined. A. spinipes Mortensen, 1924: New Zealand, *Discovery* stn 941, BMNH 1936.12.30.541–550(50).

Description of Macquarie Island material. Disc 2–6 mm d.d.. Disc scales small, 0.1–0.3 mm dia, overlapping, flat. Radial shields, 0.2 times d.d., 5 times longer than wide, separated, divergent centrally. Ventral disc scales smaller, persist until oral shields. Oral shield rounded, usually wider than long. Adorals separated radially and slightly interradially. 2 large block-like infradental papillae; distal oral papilla large oval flat, 2 times higher than wide, larger than infradental papillae. Dorsal arm plates rounded, slightly wider than long proximally, triangular or fan-shaped distally, contiguous. Ventral arm plates rectangular, slightly longer than wide, contiguous. 6–7 arm spines proximally, 4 distally, lowermost spine enlarged, 1.6 mm, up to 3 arm segments in length, slightly curved, second lowest 1 segment in length, uppermost spines smaller, subequal, two-thirds segment in length. Large oval tentacle scale, half to two-thirds arm segment long.

Reproduction. Viviparous, juvenile arms emerging from some bursae of the Macquarie Island specimens.

Colour. Dorsal disc surface grey, arms and ventral surface tan (in alcohol).

Habitat. Macquarie Island specimens collected by divers have been within *Macrocystis* holdfasts (NMV F82954). Mortensen (1924) collected New Zealand specimens from under stones, amongst algal turf, on sand and sandy mud.

Distribution. Southern South America, Falkland Islands Gough Island (0–140 m); Macquarie Island (15–450 m); New Zealand (6–20 m); Auckland and Campbell Islands (0–90 m); southern Australia (220–310 m).

Remarks. These specimens are typical of this species and closely match Mortensen's (1924) description and figures. They are also identical to New Zealand and Atlantic specimens I have examined. *A. spinipes* from New Zealand is morphologically similar, differing only in its more delicate appearance. Mortensen (1924) further distinguished the two species by their reproduction, *A. spinipes* not being viviparous or hermaphroditic.

A. magellanica has been assumed to have a circumglobal subantarctic distribution (Madsen, 1967). Mortensen (1924) suggested epiplanktonic dispersal by drifting *Macrocystis* holdfasts. However, a close examination of its reported range indicates that it has a disjunct mostly cool-temperate distribution with two separate populations, the first around the southern tip of South America and across to Gough Island in the South Atlantic and the second in the Tasman region, including New Zealand, Macquarie Island and possibly southern Australia. The time required to drift on the West Wind Drift current between New Zealand and South America is over two years making epiplanktonic dispersal unlikely (O'Hara, 1998a). Another potential explanation for this distribution is that it reflects vicariant events associated with the break up of the ancient continent of Gondwana (O'Hara, 1998a). However, it is also unlikely that two widely separate populations would retain species integrity over such a long time period and further research may find that the two populations can be distinguished on molecular or developmental grounds

Ophiactidae

Ophiactis hirta Lyman

Ophiactis hirta Lyman, 1879: 39, pl. 13 figs 365–367.—Lyman, 1882: 118–119, pl. 20 figs 4–6.—Mortensen, 1924: 126, figs 12a–c.—H.B. Fell, 1958: 26.—McKnight, 1984: 144–5.

Material examined. Northern Macquarie Ridge, 52°31′S, 160°31′E, 128 m, 23 Apr 1963, NZOI stn D18, NIWA(26).

Description of Macquarie Island material. Disc 1–4 mm d.d., arms 5 times d.d. Arms 6, often 3 arms regenerating following fission. Disc round or pentagonal, disc plates coarse, no obvious primary plates. Radial shields small, D-shaped,

divergent proximally. Few to many small pointed spines on dorsal disc surface. Oral shields diamond-shaped, as wide as long; adoral plates contiguous interradially. One triradiate apical papilla, 2–3 oral papillae. Dorsal arm plate broadly contiguous in larger specimens, rounded distally. Ventral arm plates contiguous, as wide as long, pentagonal with straight distal edge and tapered proximal end. 4 arms spines, upper spine only marginally larger than other; lower spines with swollen thorny tip. Tentacle scale to half the length of ventral arm plate.

Reproduction. The Macquarie material includes specimens asexually reproducing through fission. Division appears restricted to small specimens under 2 mm d.d.. Division fragments have a disk half and three arms. The other half of the disk and three more arms regrow along the division line. It is possible that one specimen has divided twice, having one large, two medium and three small arms. Larger specimens usually have six equal arms. One aberrant specimen has five equal arms, but is otherwise identical. A common disc anomaly is a single large radial shield rather than two smaller plates on a regenerated disc.

Colour. White in alcohol.

Habitat. Australian specimens are known from rock and sand substrates (O'Hara, unpublished data).

Distribution. Northern Macquarie Ridge (124–155 m); New Zealand and the Chatham Rise (222–688 m); southeastern Australia (160–770 m).

Remarks. These specimens are broadly similar to specimens from southeastern Australia. They differ, however, in not having an obviously enlarged upper arm spine, having thorny, swollen tips to the lower arm spines, and slightly larger tentacle scales. Fissiparity is rare in the Southern Ocean. Of the fissiparous species listed by Emson and Wilkie (1980), only the asteroid, *Allostichaster capensis* (Perrier, 1875) is known from south of 40°S, occurring along the southern coast of South America.

Ophiuridae

Ophiura (Ophiura) meridionalis (Lyman)

Plate 3g

Ophioglypha meridionalis Lyman, 1879: 56, pl. xvi figs 447–449; Lyman, 1882: 40.

Ophiura meridionalis.—Mortensen, 1936: 330–332, figs 44a–c, 45.—Madsen, 1967: 131.

Material examined. Macquarie Island, off Lusitania Bay, 54°42.5′S, 158°54.5′E, 69 m, 5 Dec 1930, BANZARE stn 83, SAM K1097(4). ANARE 1986 Expedition, BT3, NMV F60297(2).

Description of Macquarie Island material. Disc 3.5–5.0 mm d.d., arms 3 times d.d.. Disc plates thin, imbricating, primary plates and 2 interradial plates large, other plates small, 0.4 mm dia., 5 from centre to margin. Radial shields small, one-sixth d.d., contiguous. Arm comb papillae small flat rounded, usually contiguous over arm. Ventrally 1, rarely 2, large plates on margin, 6–7 smaller plates. 1–2 pointed apical papillae, 3–4 smaller rounded oral papillae. Distal oral tentacle pore with 3–5 inner, 4–5 outer tentacle scales. Oral shields large, as wide as long, distal sides rounded, proximally pointed. Adorals long and bar-like, meeting interradially, separated radially by large first ventral arm plate. Dorsal arm plates fan-shaped, longer than wide, contiguous proximally, separated distally. Ventral arm plates twice as wide as long, separated throughout. 3 short subequal conical arm spines, 0.3 mm long, third segment long. First tentacle pore with 3 scales, 1 outer and 2 inner, second with 1–2 scales, inner scale small and rim-like, other pores with 1 scale incompletely covering pore.

Reproduction. This species is viviparous and a hermaphrodite; male and female gonad separate; eggs 0.3–0.4 mm dia, 6–8 young in a bursa (Mortensen, 1936).

Colour. White in alcohol.

Distribution. Off eastern South America (1098–1890 m); South Georgia, Falkland Islands (60–249 m); Antarctica, off Enderby, Kemp and Princess Elizabeth Lands (193–1266 m); Macquarie Island (69–135 m).

Remarks. The present specimens closely match Mortensen's (1936) description and figures of this species. *O. meridionalis* has an unusual distribution. It has been found in the Antarctic and Magellanic regions, but not at other subantarctic locations besides Macquarie Island. The record of *O. meridionalis* from off the Vestfold Hills, Eastern Antarctica (Tucker and Burton, 1987, pl. 14, fig. 30) is incorrect. The specimen (TM H1975) is an *Ophiomusium* species.

Ophiura (Ophiuroglypha) irrorata Lyman

Plate 3f

Ophioglypha irrorata Lyman, 1878: 73, pl. 4 figs 106–108.—Lyman, 1882: 47–48, pl. 5 figs 7–9.

Ophiuroglypha irrorata.—Pawson, 1969: 52–54, figs 2e–f, 8–13.—McKnight, 1984: 145.

Ophiura irrorata.—Madsen, 1967: 130.
Ophiura (Ophiuroglypha) irrorata irrorata. Paterson, 1985: 123–124, figs 46, 47.

Material examined. Macquarie Island, ANARE 1986 Expedition, BT8, NMV F60298(6). Campbell Island, 58°07′S, 169°13′E, 526 m, NMV F52670(6).

Description of Macquarie Island material. Disc 6–9 mm d.d., arms (with broken tip) 3.5 times d.d. Disc plates coarse, imbricating; primary plates prominent; large circular plates to 1.1. mm dia. exist midway to margin in each interradial and radial axis; wide oval plates, 0.9 x 1.6 mm, are present in each interradial margin; other disc plates small, 0.3–0.6 mm dia. Radial shields an irregular triangle or rectangle, contiguous distally, separated proximally by several disc plates, to 1.8 mm long. Arm comb papillae short, rounded, not contiguous dorsally over arm, dorsal papillae longest. Genital slits extend from adoral shields to disc margin, bordered by small papillae. Oral shields roughly pentagonal, longer than wide with acute proximal angle and rounded distal edge. Adorals small, separated radially by first ventral arm plate. 3–5 papillae on jaw apex, to 5 squarish papillae on each jaw side, smaller than apical ones, distalmost papillae rarely widened. Dorsal arm plates contiguous for two-thirds of arm, fan-shaped with rounded distal edges, as wide as long proximally, narrower distally. Ventral arm plates contiguous for first 3–4 plates, first 2–3 plates squarish, fourth plate triangular, others widely separated, 2–3 times as wide as long. Second oral tentacle pore opens into jaw slit, elongate with 5 inner and 8 outer scales. Pores decrease rapidly in size over the next 6 plates, 4 inner and 5 outer scales on first arm pore, 2 and 3 on next 2 plates, reducing to 1 scale. Small supplementary plate on outer distal corners of arm segments 1–4. 3 small, peg-like arm spines, to 0.3 mm long, dorsal spine little separated from other two. Middle spine modified into upturned hook on distal arm segments.

Reproduction. Unknown.

Colour. Tan in alcohol.

Habitat. Mud (Lyman 1882); rock (Pawson, 1969; McKnight, 1984).

Distribution. Cosmopolitan (71–5870 m); Macquarie Island (71–450 m).

Remarks. These specimens are broadly similar to those described by Pawson (1969) from New Zealand, except that Pawson's specimens differ in having supplementary arm plates that persist until the arm tip and low widened distalmost oral papillae. *O. irrorata* is a very polymorphic species (Paterson, 1985) and these differences do not appear significant. Six specimens from off Campbell Island were examined for comparison (NMV F52670). These are smaller (to 4.5 mm d.d.), but similar to the Macquarie specimens and also lack distal supplementary arm plates after the fifth arm segment. Pawson (1969) noted that his specimens could be distinguished from other *O. irrorata* material by the coarseness of the disc plates and may represent a new species. In many ways the Macquarie Island specimens are similar to *O. mundata* (Koehler, 1906) (as described and figured by Paterson, 1985) from the north Atlantic. However, *O. mundata* has no supplementary arm plates. Madsen (1967) noted that *O. irrorata* is cosmopolitan in abyssal seas, extending into the sublittoral in the Southern Ocean.

Ophioplocus incipiens (Koehler)

Plate 3h

Ophioceres incipiens Koehler, 1922b: 48, pl. 84 figs 1–6, 13–14.—Mortensen, 1936: 307.—H.B. Fell, 1961: 69, pl. 1a fig. 3, pl. 2a fig. 1, pl. 3 fig. 2, pl. 9 fig. 2.—Madsen, 1967: 137.—Pawson and Rowe, 1977: 352.—Baker and Devaney, 1981, figs 3, 6–9.
Ophioplocus incipiens.—Thomas, 1975: 239–240.

Material examined. ANARE 1986 Expedition, BT6, NMV F60299(1).

Description of Macquarie Island material. Disc 9 mm d.d., arms > 35 mm. Disc scales small, 0.25 mm dia, imbricating, 15 scales from centre to margin, primary plates evident. Radial shields small, 0.8 mm long, oval, widely separated. Ventral disc plates smaller, genital slit 1 arm segment long. 4 oral papillae and 1 underlying oral tentacle scale on jaw edge. Trapezoid oral shields, adorals meet interradially, separated radially by small first ventral arm plate. Dorsal arm plates fragmented, proximally into 2 large outer fragments separated by 2–3 smaller central fragments, distally the 2 larger fragments joined at the distal end and 2–3 smaller fragments are confined to proximal end. Ventral arm plates pentagonal, convex distally. 2, sometimes 3, stout flattened pointed arm spines, lowermost longest, half segment long, 0.6 mm long. 2 tentacle scales, large oval scale on lateral arm plate, smaller rim-like scale on ventral arm plate.

Reproduction. Protandric hermaphrodite, viviparous (Mortensen, 1936).

Colour. Macquarie specimens (in alcohol) tan.

H.B. Fell (1961) recorded live colour as blue-grey or purple disc with cream or pinkish-yellow arms.

Habitat. Polyzoa (H.B. Fell, 1961)

Distribution. Antarctica, off Enderby, MacRobertson, Princess Elizabeth, King George V Lands, Ross Sea (110–603 m); South Georgia, South Shetland, Clarence Islands (60–342 m); Macquarie Island (25–29 m).

Remarks. The discovery of *O. incipiens* at Macquarie Island is surprising as it has been previously reported only from Antarctic waters. A closely related species is found in the subantarctic islands of New Zealand. This was originally referred to *O. huttoni* (Farquhar, 1899) but Baker and Devaney (1981) restricted the known distribution of *O. huttoni* to the northern island of New Zealand, recognising *O. marginata* (H.B. Fell, 1953) as the southern and subantarctic New Zealand species. Baker and Devaney (1981) distinguished *O. marginata* from *O. incipiens* by the shorter arms, only twice d.d., and the relatively simple pattern of dorsal arm plate fragmentation.

Ophioleuce regulare (Koehler)

Plate 3i–j

Ophiopyren regulare Koehler, 1901: 26, pl. VIII figs 52–54.

Ophiopyren regularis.—Madsen, 1967: 129.—McKnight, 1984: 145.

Ophioleuce regulare.—Madsen, 1983: 45–48, figs 7a–g [full synonymy].—O'Hara, 1990: 293–294.

Material examined. Macquarie Island, off Lusitania Bay, 54°42.5′S, 158°54.5′E, 69 m, 5 Dec 1930, BANZARE stn 83, SAM(13). ANARE 1986 Expedition, BT4, NMV F60314(1).

Description of Macquarie Island material. 1.5–5.0 mm d.d., arms delicate, slender, mostly broken, approx. twice d.d., triangular in cross section. Disc slightly convex dorsally, ventrally flat or concave; plates large, 0.6 mm long, mostly bordered by 1–4, usually 2, rows of spherical granules; margin tapers to sharp edge, bears several rows of elongate pointed granules. No granules ventrally. Oral shields pentagonal, as wide as long, distal edge overlain by ventral disc plates. Adoral shields contiguous interradially, separated radially by ventral arm plates. 1 elongate pointed apical papilla, 5–7 oral papillae, inner elongate, others low flat rounded, distal 1–2 papillae function as outer scales of second oral tentacle pore, opposed by 1–2 inner scales on first ventral arm plate. Dorsal arm plates with convex distal edge, contiguous proximally, some slightly carinate. Ventral arm plates rhombic or triangular, contiguous until just outside disc margin. 2 small pointed arm spines. Proximal tentacle pores elongate with 1–3 inner and 1–2 outer scales, distal pores round with 1 flat oval scale.

Reproduction. Sexes separate (Mortensen, 1936).

Colour. White in alcohol.

Habitat. Mortensen (1936) speculated that this species lives attached to stones or other hard substrates.

Distribution. Circumpolar Antarctica (100–900 m); South Georgia (160 m); Macquarie Island (65–438 m); southeastern Australia (770–841 m).

Remarks. The present specimens closely match the full description given by Madsen (1983).

Class Echinoidea

Key to Macquarie Island Echinoidea

1. Primary spines numerous, secondary spines similar but shorter and evenly distributed over the test ..... *Pseudechinus novaezealandiae*
— Primary spines few and very large, secondary spines much smaller, distributed in wreathes around the primary spines and in rows up the ambulacra 2
2. Apical primary spines with prominent basal and terminal discs .... *Goniocidaris parasol*[a]
— Apical primary spines with small terminal cup-like discs and basal spurs .... *Goniocidaris umbraculum*[a]

Notes on key:

[a] Two cidaroid echinoids have also been reported from near Macquarie Island. Pawson (1968a: 13–15, fig. 1.1) and McKnight (1984: 145) recorded *Goniocidaris umbraculum* (Hutton, 1879a) from the northern Macquarie Ridge (NZOI stns D17 and D18, 52°31′S, 160°31′E, 124–128 m, 23 Apr 1963). F.J. Fell (1976) recorded *Goniocidaris parasol* H.B. Fell, 1958

from *Eltanin* Cruise 16, stn 1411 also on the northern Macquarie Ridge (51°00′S, 162°01′E, 333–371 m, 8 Feb 1965). *G. parasol* is distinguished from *G. umbraculum* by the presence of basal and terminal discs on the apical primary spines. On the holotype of *G. parasol* (see H.B. Fell, 1958: 32–34, pl. 3 fig. b, pl. 5 fig. b) these discs are very large and join together to form a complete shielding system over the aboral surface. However, F.J. Fell (1976) found that not all specimens have terminal discs and that basal discs do not develop until a horizontal diameter of 20 mm is reached. As Pawson's (1968a) specimens were small, < 19 mm diameter (McKnight supplied no data for his specimens), it cannot be determined if one or two species of *Goniocidaris* occur around Macquarie Island. F.J. Fell (1976) also records both species and the similar species "*Austrocidaris*" *pawsoni* McKnight, 1974 and *Ogmocidaris benhami* Mortensen, 1921 from the subantarctic islands of New Zealand. Both *G. parasol* and *G. umbraculum* are known to brood their young (Barker, 1984).

Order Temnopleuroida

Temnopleuridae

Pseudechinus novaezealandiae (Mortensen)

Plate 4a–b

Notechinus novaezealandiae Mortensen, 1921: 153, pl. 6 figs 7–10, pl. 7 figs 4, 5, 7–11.—Koehler, 1926: 36, pl. 54.

Pseudechinus novaezealandiae.—Mortensen, 1943: 237, figs 117–118, 120b, 121b, 126c.—Pawson, 1968a: 15–16, fig. 1(2).—Bennett, 1971, pl. 56, fig. 5.—Simpson, 1982: 50.—McKnight, 1984: 145.

Material examined. Macquarie Island, Garden Cove, 1957, NMV F60309(1); 14 Jul 1963, NMV F60310 (1); 5 May 1965, NMV F60311(1); opposite Gadget Gully, 1 Jul 1962, NMV F60312(1). ANARE 1986 Expedition, BT2, MNV F60304(6); BT3, NMV F60302(4); BT4, NMV F60305(3); BT6, NMV F60303(1); BT10, NMV F60301(3). AM 1977–1978 Expedition, Gorilla Head Rock (9 m), MA-148(1); Tottan Head, Goat Bay (14 m), MA-371(2), MA-374(1), MA-375(3); Tern Rock Bay (10 m), MA-37(1); Garden Cove (8-14 m), MA-14(3); MA-87(4), MA-123(1), MA-124(3), MA-125(3), MA-127(2), MA-128(11), MA-379(2); Sandy Bay (16 m), MA-241(6); Green Gorge (0.5–18 m), MA-245(10), MA-246(1), MA-247(11), MA-248(1), MA-251(11), MA-267(1), MA-281(1), MA-291(1), MA-292(1), MA-294(4); Caroline Cove (13 m), MA-306(3); Aerial Cove (5 m), MA-52(2), MA-107(1). *Eltanin* Expedition, 54° 31.0′S, 159° 00.0′E, 110 m, 12 Feb 1965, cruise 34 stn 2215, USNM(1).

Description of Macquarie Island material. Horizontal diameter to 51 mm, 36 mm high. Test shape hemispherical, oral side flattened, circumference round, slightly sunken perisome. Spines short, to 7 mm, coarse and dense; not curved at perisome. Primary ambulacral spines form regular series, their tubercules sometimes confluent. Secondary spines, their tubercules half diameter of primary spines, form longitudinal rows in median area, and also present among pore pairs. Interambulacral areas closely covered in spines, some secondary tubercules almost as wide as primary ones, forming 1–2 rows inside each primary series. Apical system small, one-sixth test diameter, plates closely tuberculate. Ocular 1 insert, other oculars exsert. Periproct oval, anal opening posterior. Complete circle of larger plates border periproct, smaller elongated plates border anal opening. Perisome naked. 2 types of globiferous pedicellariae, larger ones with short robust valves, with 1–3 teeth on each side, smaller ones with 1 tooth on each side. Tridentate pedicellariae small inconspicuous, valves with narrow serrated edges.

Reproduction. Separate sexes, female gonads large, with numerous small eggs (0.08–0.1 mm). The larval stage is probably planktonic (Mortensen, 1921; Simpson, 1982).

Colour. Macquarie Island specimens (live) with grey, green or brown test, dark green spines, with white, grey or occasionally violet tips.

Habitat. On Macquarie Island it is found rarely by shore collectors in deeper rock pools or as beach drift. Divers (2–20 m) have found it mainly on sponge-bryozoan mats, sheltered rock surfaces, or sometimes amongst the holdfasts of *Desmarestia* and *Macrocystis*. Common in dredged samples to 433 m. Pawson (1968a) recorded this species from rock and sand substrata.

Distribution. South Island of New Zealand (0–100 m); Auckland, Campbell, Bounty and Antipodes Islands, Campbell Rise (0–306 m); Macquarie Island (0.5–433 m).

Remarks. *P. novaezealandiae* is the most common echinoid from Macquarie Island as well as southern New Zealand (Pawson, 1968a). *P. marionis* (Mortensen, 1936) from Marion Island, Kerguelen and Gough Island differs in having slender white spines, a white or greenish test, and much larger suranal plates than *P. novaezealandiae*. *P. magellanicus* (Philippi, 1857) from the Magellanic region and Tristan da Cunha has a red test and spines.

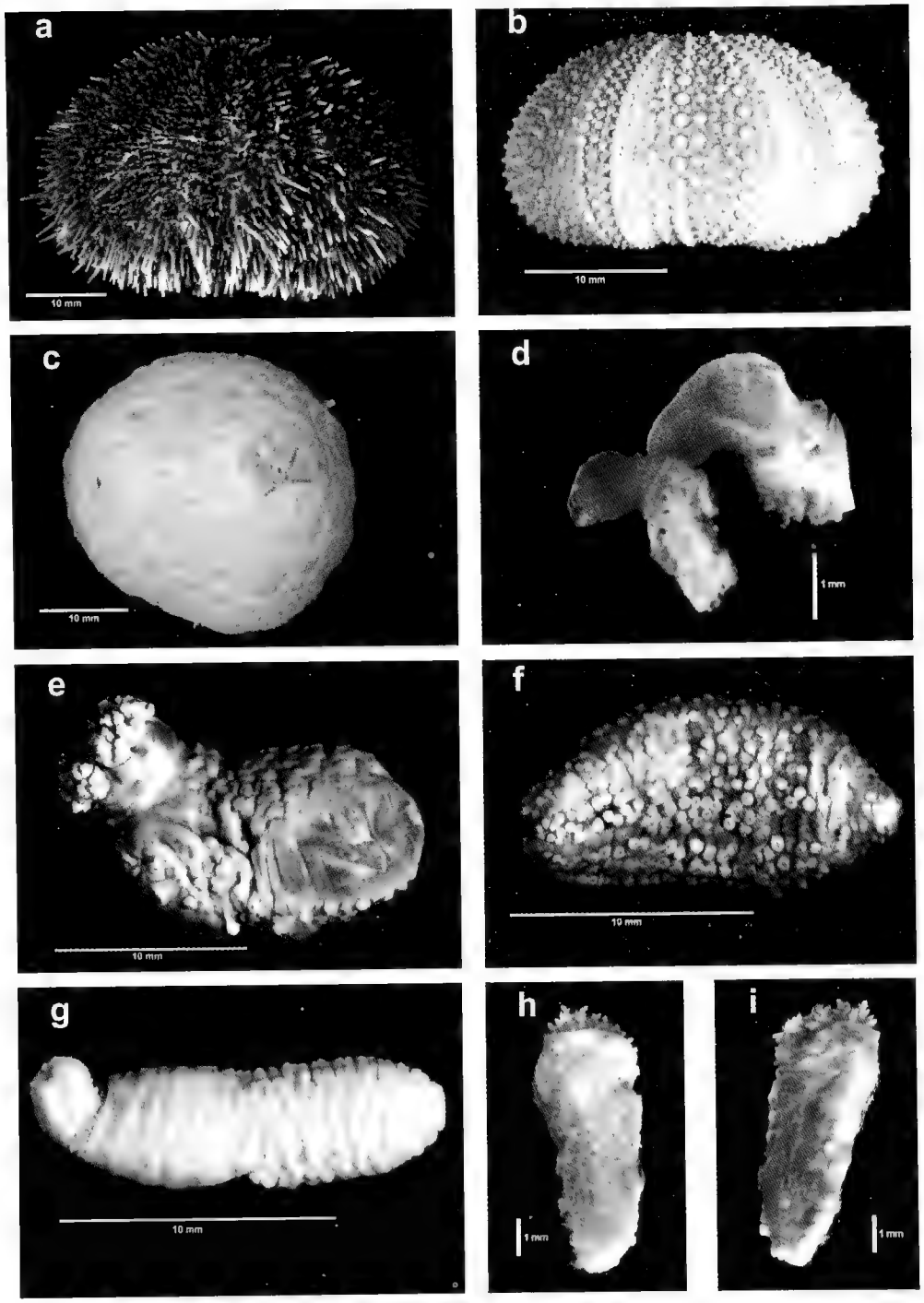

Plate 4. a, *Pseudechinus novaezealandiae*, lateral view, NMV F60309; b, *Pseudechinus novaezealandiae*, lateral view of test, NMV F60312; c, *Psolus neozelanicus*, dorsal view, NMV F60306; d, *Taeniogyrus dunedinensis*, NMV F77775; e, *Pseudopsolus macquariensis*, lateral view, NMV F76189; f, *Trachythyone macphersonae*, dorsolateral view, NMV F76113; g, *Pseudocnus laevigatus*, dorsolateral view, NMV F76118; h, *Trachythyone nelladana*, holotype, dorsal view, NMV F83072; i, *Trachythyone nelladana*, holotype, ventral view, NMV F83072.

Class Holothuroidea

Key to Macquarie Island Holothuroidea

1. Tube feet present 2
— No tube feet 9
2. 10 dendritic (branched) tentacles; shallow water and shelf species 3
— 15–20 disc, quadrilobed or shield shaped tentacles; bathyl species 8
3. Tube feet mostly absent from the dorsal surface (1–2 may be present anteriorly), ventral sole present 4
— Tube feet common on dorsal surface 6
4. Dorsal surface covered in thick leathery skin, few ossicles, pedicles in 3 rows on all ventral radii ..... *Pseudopsolus macquariensis*
— Dorsal surface covered by imbricating plates or scales. Midventral radius without tube feet except at each end or rarely in middle 5
5. Dorsal surface covered in large scales; up to 6.0 mm long, body flattened, mouth and anus dorsal in position ..... *Psolus neozelanicus*
— Dorsal surface covered in imbricating plates (0.3–0.5 mm long); mouth and anus anterior/posterior in position ..... *Trachythyone nelladana* sp. nov.
6. Tube feet scattered on dorsal surface, not restricted to radii ..... *Trachythyone macphersonae*
— Tube feet restricted to radii 7
7. Cup ossicles present, ventral pair of tentacles reduced in size ..... *Ocnus calcareus*[a]
— Cup ossicles absent, plate ossicles "pine-cone" shaped, denticulate end constricted into definite neck. 10 equal sized tentacles ..... *Pseudocnus laevigatus*
8. Body soft; 15 disc shaped tentacles, dorsal papillae apparently absent; ossicles concave wheels of 2 types, largest with 10 or more spokes and ventral rods finely spinous along their length ..... *Laetmogone* sp.[b]
— Body firm; 19–20 quadrilobed tentacles; pedicels restricted to double row on posterior section of midventral radius; few scattered processes on expanded dorsolateral margin of body; ossicles with 4 subequal elongate processes ..... *Paelopatides ovalis*[c]
— Body flaccid; 20 shield shaped tentacles, tube feet in 2–4 rows on ventral radii, dorsal surface with 6 rows of papillae; ossicles cruciform plates with 3–4 bifurcated or perforated arms and central pillar ..... *Synallactes challengeri*[d]
9. Wheels ossicles present; skin smooth or wrinkled but not papillate ..... *Taeniogyrus dunedinensis*
— Wheels rare or absent; anterior body wall with papillae ..... *Taeniogyrus* sp.

Notes on key:

[a] McKnight (1984: 145) recorded the New Zealand species *Ocnus calcareus* (Dendy, 1896) (Cucumariidae: Dendrochirotida) from three NZOI stations off Macquarie Island (71–433 m). I have re-examined holothurians from one of the stations (D10) and found only three species: *Trachythyone macphersonae, Pseudocnus laevigatus*, and *Taeniogyrus dunedinensis*. As there is no indication with the material whether it includes all McKnight's specimens, further confirmation is required of the existence of an *Ocnus* species from Macquarie Island. Mortensen (1925: 335) recorded *O. brevidentis* (Hutton, 1872) from Macquarie Island but suspected that the locality label was an error.

[b] A single damaged specimen of an undescribed *Laetmogone* species (Laetmoginidae: Elasipodida) was collected south of Macquarie Island by the *Eltanin* expedition (56° 19.2′S, 158° 29′E, 833–842 m, 12 Feb 1965, cruise 16, stn 1422, identified by M. O'Loughlin, USNM E27630). This species also occurs on the seamounts south of Tasmania (M. O'Loughlin, pers. comm..) in depths of 1580–1700.

[c] A single specimen (130 mm long) of *P. ovalis* (Walsh, 1891) (Synallactidae: Aspidochirotida) has been recently trawled near Macquarie Island (54° 46.2′S, 158° 42′E, 930–815 m, 17 Jan 1995, identified by M. O'Loughlin, NMV F80184). This species is otherwise known from bathyl depths (911 -1611 m) off the Andaman Islands in the Indian Ocean and east of Cape York in the Coral Sea (M. O'Loughlin, pers. comm.).

[d] A single damaged specimen of *S. challengeri* (Théel, 1886) (Synallactidae: Aspidochirotida) was collected off Macquarie Island by the *Eltanin* expedition (54° 31.0′S, 159° 00.0′E, 110 m, 12 Feb 1965, cruise 34, stn 2215, identified by M. O'Loughlin, USNM E47579). This species also occurs off Crozet, Marion and Prince Edward Islands (237–600 m) (Massin, 1992) and off

Order Dendrochirotida

Psolidae

Psolus neozelanicus Mortensen

Plates 4c, 5a–b

Psolus neozelanicus Mortensen, 1925: 362–363, figs 44, 45.—Pawson, 1970: 28.

Psolus antarcticus.—Pawson, 1968a: 19–21, fig. 2(1–4).—McKnight, 1984: 145.—O'Hara, 1998a: 146. [non *Psolus antarcticus* (Philippi, 1857)]

Material examined. Macquarie Island, ANARE 1986 Expedition, BT2, NMV F76117(1); BT3, NMV F60306(9). *Eltanin* Expedition, 54° 30.0′S, 158° 59.0′E, 112–124 m, 15 Feb 1967, cruise 27 stn 1974, USNM E33647(1).

New Zealand, 2 miles east of North Cape, 102 m, 2 Jan 1915, Mortensen, ZMUC(2 syntypes of *P. neozelanicus*).

Description of Macquarie Island material. Up to 50 mm long, 40 mm wide, 10 mm high; body flattened, limpet-like, mouth and anus dorsal, mouth highest point, tapering on all sides to thin sharp margin. Tentacles 10, ventral pair smaller, dendritic. Anus and mouth each with 5 large triangular valves. Dorsal surface covered in large imbricating scales. Several rows of smaller scales surround margin, mouth and anus, and lie scattered between larger scales. No dorsal tube feet. Conspicuous flattened ventral sole with 2 rings of tube feet, those on outer ring (on margin of larger specimens) are small and sparse, those on inner ring (several mm from margin) are larger and form biserial or zigzag row; few tube feet at each end of midventral radius on larger specimens. Calcareous ring plates robust with concave posterior edge and slender anterior process; 1 polian vesicle

Dorsal ossicles large multi-layered perforated scales up to 6.0 mm long (body length 38 mm), to 2.5 mm long on smaller specimens (body length 12 mm). Scales with several small grain-like projections on the dorsal surface, 0.15 to 0.25 mm wide, consisting of the same multi-layered framework as the scale body. No cups. Ventral ossicles scattered knobbed perforated buttons. Buttons with 4 large central holes and 4–20 smaller peripheral holes, up to 30 scattered small knobs, jagged margins, up to 0.11 mm long (pl. 5a–b). Tube feet each with typical ventral ossicles, slightly concave, up to 0.25 mm wide, with up to 33 perforations. Tentacles with perforated plates of 3 types: 1) triangular shaped to narrow/bent plates with numerous perforations and denticulate margin, typically 0.16 mm long; 2) flat irregular plates with 4–6 large perforations, typically 0.12 mm long; 3) smaller finer plates, square, slightly concave, numerous small perforations, typically 0.08 mm long (digit endpieces).

Reproduction. Sexes separate, gonads consisting of numerous long unbranched tubules, gonopore dorsal, posterior to mouth; numerous eggs in female gonad tubules, average size 0.5 mm dia. Mortensen (1925) reported egg sizes of 0.2 mm in his small specimens.

Colour. Macquarie Island material (in alcohol) brown or pale dorsal surface, pale sole.

Habitat. Several specimens (NMV F60306) were found attached to dead shells of the scallop *Chlamys patagonica delicatula* (Hutton); also recorded from rock (Mortensen, 1925).

Distribution. New Zealand (102 m); Macquarie Island (91–415 m).

Remarks. The Macquarie Island *Psolus* material appears conspecific with *P. neozelanicus* rather than *P. antarcticus* as proposed by Pawson (1968a). *P. neozelanicus* is only known from the two small type specimens from North Cape, New Zealand (length 7–10 mm). These specimens have the same grain-like projections on the dorsal scales as the Macquarie Island material. These projections possibly function in a similar fashion to cup ossicles. The types lack the small outer tube feet, however this is also true of smaller Macquarie Island specimens (≤ 13 mm body length). The larger type specimen has lateral margins that are coiled ventrally giving the body an atypical cylindrical shape, probably an artefact of preservation (Mortensen, 1925). A similar body form occurs on two small (9–13 mm length) Macquarie Island specimens (NMV F60306). *P. antarcticus* from the Magellanic region is very similar except it appears to lack the small grain-like projections on the dorsal scales; instead its scales have been described as smooth or very finely granulated (Théel 1886). Pawson (1968a) distinguished *P. neozelanicus* from *P. antarcticus* by the presence of several rings of small dorsal scales surrounding the anus and

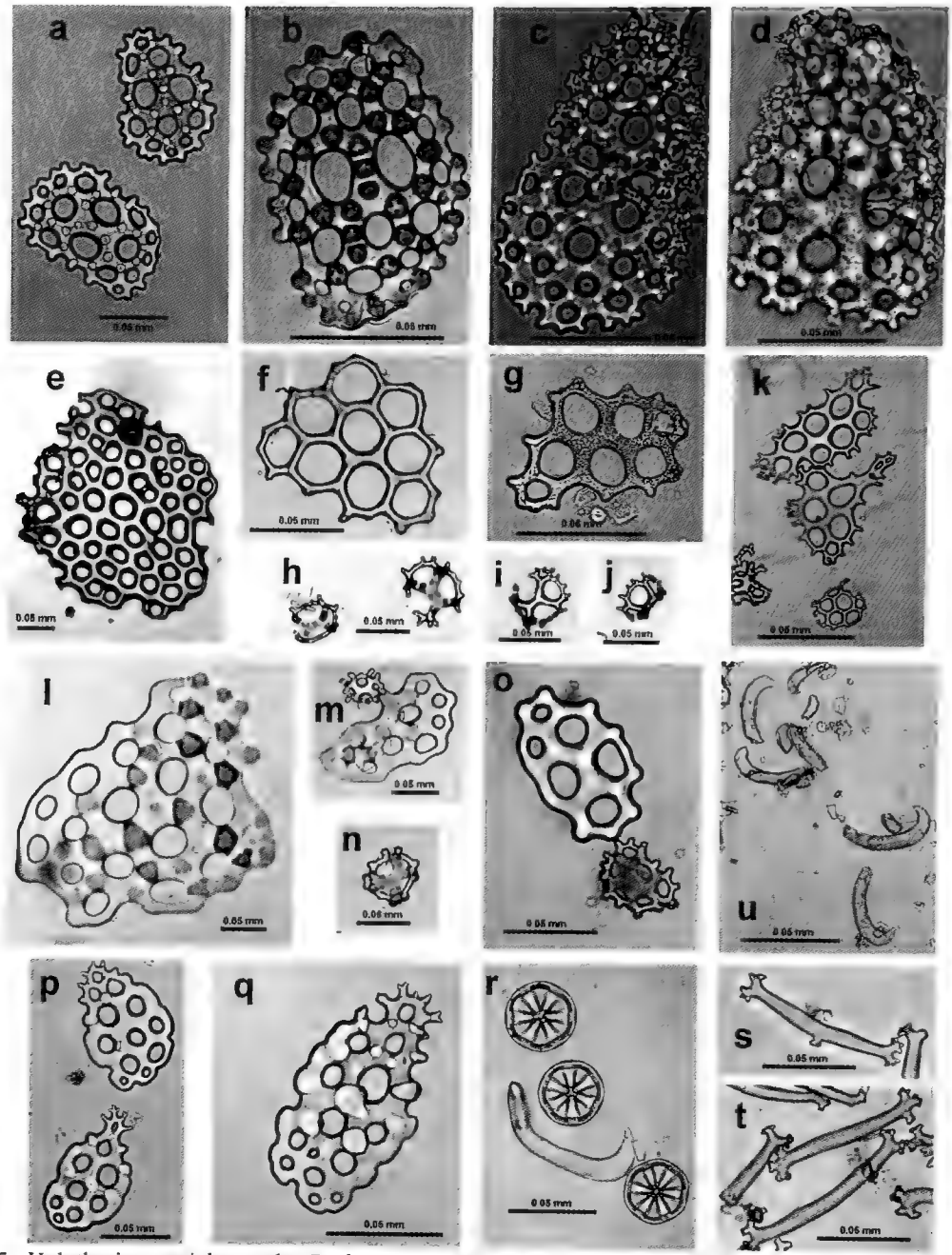

Plate 5. Holothurian ossicles. a–b, *Psolus neozelanicus*, NMV F60306, ventral knobbed plates; c–d, *Pseudopsolus macquariensis*, NMV F76198, dorsal ossicles, showing incipient secondary network in centre of plates; e–k, *Trachythyone nelladana*, NMV F77770: e, dorsal plate; f–g, plates from sole; h, dorsal cups, view from above; i, dorsal cups, view from below; j, dorsal cups, view from side; k, tentacle ossicles; l-o, *Trachythyone macphersonae*: l, dorsal plate from juvenile, NMV F77772; m, dorsal plate and cup (viewed from below) from adult, NMV F77773; n, dorsal cup from juvenile (viewed from above), NMV F77772; o, dorsal plate and cup (viewed from above) from adult, NMV F76116; p–q, *Pseudocnus laevigatus*, NMV F76118, body wall plates; r–t, *Taeniogyrus dunedinensis*: r, sigmoid hook and wheels from body wall, NMV F77775; s, tentacle ossicle with lateral process, NIWA; t, tentacle ossicles, NIWA; u, *Taeniogyrus sp.*, sigmoid hooks, AM J22904.

greater number of perforations on the sole ossicles. However, these features vary in the Macquarie Island material. Both species are distinguished from related Australasian and Southern Ocean species by the lack of a continuous row of midventral tube feet and the presence of only five large anal and oral valves (Pawson, 1968a).

Cucumariidae

Pseudopsolus macquariensis (Dendy)

Plate 4e, 5c–d

Psolus macquariensis Dendy, 1896: 41, pl. 7 figs 70–72.

Pseudopsolus macquariensis.—Pawson, 1968b: 143–144, fig. 1 [full synonymy].—Pawson, 1970: 38.—Bennett, 1971, pl. 32.—Simpson, 1982: 45–48, figs 7–9.

Material examined. Macquarie Island, Secluded Beach, 27 Nov 1989, NMV F76189(3); Garden Cove, 5 Dec 1960, NMV F45003(16); 12 Aug 1962, NMV F76190(3); 17 Jan 1964, NMV F76200(10); 16 Jun 1967, NMV F76191(2); 14 Mar 1969, coll R.D. Simpson, AM J8177(12); 25 Nov 1989, NMV F76192(9); 26 Nov 1989, NMV F76193(6); Buckles Bay, 7 Dec 1986, NMV F60307(3 juv); 8 Dec 1986, NMV F60308(2); Nugget Point, 15 Dec 1962, NMV F76194(1); Hurd Point, 29 Jan 1964, NMV F76195(1); Bauer Bay, 27 Jan 1967, NMV F76196(3); Hasselborough Bay, 23 Aug 1962, NMV F76197(8); Hasselborough Point, 24 Jan 1964, NMV F76199(2); Aerial Cove, 28 Nov 1989, NMV F76198(5). AM 1977–1978 Expedition, Tern Rock Bay (7 m), MA-35(1); Garden Cove (1–10 m), MA-14(5), MA-356(33), MA-360(69); NE Buckles Bay (intertidal), MA-93(100); Green Gorge (intertidal–0.7 m), MA-255(1), MA-256(2), MA-258(2), MA-259(2), MA-281(1), MA-282(5).

Description of Macquarie Island material. Up to 40 mm long and 16 mm wide (AM J8177), body barrel-shaped, with a tapered anus (unless fully contracted), anus and mouth slightly dorsally upturned. 10 equal tentacles, dendritic, each with 4 major bushes on pronounced stalk. Mouth in centre of large oral disc. Introvert thick and muscular. Dorsal body wall covered in thick smooth leathery skin, dorsal radii sometimes visible. Conspicuous ventral sole, skin notably thinner than on dorsum. Dorsal tube feet restricted to 1–2 small ones on introvert. Ventrolateral radii with 1–3 rows of tube feet, outer row largest. Midventral radii with 1–2 rows of pedicles, often tube feet in each row placed alternately, in zigzag arrangement. Pair of knotty protuberances are present midventrally on specimens collected in late winter-spring.

Dorsal ossicles perforated plates, varying in density from scarce to abundant and overlapping, typically 0.08–0.14 mm long, with 2–4 large central perforations and smaller peripheral perforations, small knobs, sometimes coalescing into secondary layers, margins denticulate (pl. 5c–d). No tube foot or tentacle ossicles.

Reproduction. Macquarie Island material usually with separate sexes, but with some specimens showing successive hermaphroditism. Two compartmentalised brood sacs are present with an opening to the exterior. Large eggs (to 1.8 mm dia) develop in ovaries from December to June. In May–June, eggs are transferred to the brood sacs, possibly by an external process. Release of juveniles occurs in late September–October, apparently in a highly synchronised fashion (Simpson, 1982).

Colour. Macquarie Island specimens (live) with dorsal surface coloured light to dark brown, reddish or purplish; introvert, tentacles, anal cone and sole sometimes paler. Brown spots sometimes present between tentacles.

Habitat. Lower intertidal pools and rock surfaces (0–1 m), subject to wave action, sometimes exposed at low tide; amongst *Durvillaea* holdfasts, sometimes on coralline algae or *Codium*. Only two of the current 295 specimens were collected from subtidal depths (7 and 14 m).

Distribution. Macquarie Island (0–14 m).

Remarks. This species is very common on rocky substrates in the lower intertidal zone. The sole is used to adhere strongly to the substrate and the tentacles are extended into the surf. Pawson (1968b) described internal anatomy in detail. Simpson (1982) noted the pair of protuberances which appear on the ventral body surface, near the openings to the brood sacs, on specimens collected during the juvenile release period in spring. In this collection they are present in specimens collected as early as August. Their function is unknown.

P. macquariensis gruai has been described from Kerguelen by Cherbonnier and Guille (1975). Kerguelen specimens are similar to Macquarie specimens in overall morphology and habit. They appear to differ in having ossicles in the tube feet and tentacles, and possibly in their developmental biology. Cherbonnier and Guille (1975) described the gonads as being very long and fine, with relatively few eggs measuring 1µm in diameter. A record of *P. macquariensis* from Stewart Island south of New Zealand is

probably a locality error (Mortensen, 1925; Pawson, 1970).

Pseudocnus laevigatus (Verrill)

Plates 4g, 5p–q

Pentactella laevigatus Verrill, 1876: 68.

Cucumaria laevigata.—Ludwig and Heding, 1935: 179-185, fig. 43.

Pseudocnus laevigatus.—Pawson, 1968b: 145, figs 2–11 [full synonymy].—Bennett, 1971, pl. 56 fig. 6a. –Simpson, 1982: 48.

Pseudocnus leoninoides.—Pawson, 1968a: 22. [non *P. leoninoides* (Mortensen, 1925)]

Material examined. Macquarie Island, Garden Cove, 26 Dec 1965, I. Bennett, det. Pawson, F45102(1); 26 Nov 1989, NMV F76119(1); off Buckles Bay, 54°30′S 158°58′E, 15 m, 19 Oct 1983, NMV F82953(8); Aerial Cove, 28 Nov 1989, NMV F76118(1); 54°40′S, 159°01′E, 71 m, NZOI stn D10, NIWA (3). AM 1977-1978 Expedition, Gorilla Head Rock (11–12 m), MA-146(2); Tottan Head, Goat Bay (2.4–14 m), MA-39(1), MA-41(1), MA-365(2), MA-371(9), MA-374(11), MA-375(9), MA-376(16); Tern Rock Bay (7 m), MA-35(6); Garden Cove (6–14 m), MA-14(2), MA-91(4), MA-123(1) MA-124(8), MA-125(23), MA-127(5), MA-128(18), MA-350(1), MA-379(19); Sandy Bay (15–16 m), MA-237(2), MA-241(57); Green Gorge (6–18 m), MA-245(7), MA-247(8), MA-248(3), MA-250(4), MA-251(3), MA-267(1), MA-275(3), MA-289(1), MA-291(1), MA-292(13), MA-294(7); Caroline Cove (8–18 m), MA-298(7), MA-300(2), MA-306(3), MA-307(2), MA-311(2); Handspike Point (intertidal), MA-136(2); Aerial Cove (0–6 m), MA-46(2), MA-47(14), MA-50(8), MA-54(2), MA-55(1), MA-83(12), MA-85(65), MA-86(1), MA-98(1), MA-102(35), MA-107(54), MA-108(100), MA-109(12), MA-110 (30), MA-382(10), MA-383(1), MA-386(155), MA-388(4), MA-389(15); Anchor Rock (13–20 m), MA-89(21), MA-95(6). ANARE 1986 Expedition, BT2, NMV F76120(5); BT3, NMV F76121(14); BT4, NMV F76122(3); BT5, NMV F76123(2). *Eltanin* Expedition, 54°24′S, 159°01′E, 10 Feb 1965, 79-93 m, cruise 16, stn 1417, USNM E43134(5); 54°31.0′S, 159°00.0′E, 18 Jun 1968, 110 m, cruise 34, stn 2215, USNM(1).

Description of Macquarie Island material. Body cylindrical, up to 35 mm long (preserved). Preserved material often highly contracted, with body wall becoming thick and wrinkled or body becoming twisted. 10 equal tentacles. Introvert very long and thin when extended. Ventral and dorsal body surface similar, no sole. Pedicels restricted to radii, in 1–2 zigzag rows, extending from anus to anterior end, including across introvert. Body wall dense with small pine-cone shaped ossicles (pl. 5p–q). Ossicles 0.08–0.15 mm long, 0.075–0.14 mm wide, with 4–5 large central and smaller peripheral holes, covered in large knobs, one end attenuated and denticulate. Denticulate end orientated externally giving body surface a rough texture. Some rare x-shaped plate precursors, 0.03 mm long. Plates slightly smaller ventrally. Introvert ossicles irregular perforated plates, few knobs. Tube feet plates narrow and bent, widened centrally and attenuated at each end, large perforation in centre; end pieces 0.15–0.27 mm dia. Tentacle ossicles are 2 kinds of perforated plates, irregular shapes, large plates typically 0.2 mm long, occasionally knobbed, smaller plates finer, 0.7 mm long.

Reproduction. Sexes separate. Gonads short unbranched tubules. Females with few eggs in each gonad; Macquarie Island specimens with eggs in November to 0.7 mm dia; Kerguelen specimens with eggs in January to 1.4 mm dia (Pawson, 1968b). Eggs transferred to brooding sacs in November. A pair of brooding sacs are attached on either side of the ventral midline in the posterior half of the animal. The sacs are invaginations of the body wall opening to the exterior through a vestibule with a slit-like aperture (Pawson, 1968b). Brood juveniles in December measure 3 mm long, with a few tube feet on the radii, visible tentacles and scattered ossicles in the body wall. Simpson (1982) found up to 93 young in the internal brood pouches of a specimen 35 mm long from Macquarie Island (no date supplied). Small juveniles are present in samples from December to February, which may have been free living or expelled from the brood sacs during collection of adults.

Colour. Macquarie Island material (live) light pink to orange-pink with distinct brown dots on the tentacle trunks and at the bases of the pinnae. Marion Island specimens white or orange (Pawson, 1971).

Habitat. Macquarie Island: sublittoral, under rocks or sheltering between encrusting sponges or the green alga *Codium*, within *Macrocystis* holdfasts, and rarely on sand. Can be locally numerous under sheltered rock overhangs. Marion Island specimens recorded from rock, gravel, sand and sand with mud (Branch et al., 1993).

Distribution. Marion Island (0.5–240 m); Crozet, Kerguelen, Heard Islands (0.5–275 m); Macquarie Island (0.5–135 m). Théel (1886) recorded one small specimen from 1023 m south of Crozet Island (as *Cucumaria serrata* var. *marionensis*).

Remarks. P. laevigatus is a polymorphic species or species complex that has been reported widely throughout the subantarctic. The shape of the

ossicles can vary from the typical "pine-cone" shape, present at Macquarie Island, to elongated plates found on animals near Heard Island, to being very irregular at Kerguelen (M. O'Loughlin, pers. comm.). Théel (1886) attempted to separate regional varieties of this species (as *Cucumaria serrata*) but these have been abandonned by later researchers. However, similar forms from South America and New Zealand are known as *P. perrieri* (Ekman, 1927) and *P. leoninoides* (Mortensen, 1925) respectively.

Pawson (1968a) recorded a single specimen of *P. leoninoides* from NZOI station D18, 150 miles NNE of Macquarie Island (52°31′S, 160°31′E, 128 m, 24 Mar 1963, NIWA). Pawson (1970) suggest that further material may reveal that the Macquarie specimen represents a different species. M. O'Loughlin (pers. comm.) who has examined this specimen believes its affinities lie more with *P. laevigatus* than *P. leoninoides*. *P. leoninoides* is known from the rocky shallows of Campbell, Auckland and the Snares Islands and apparently differs from *P. laevigatus* in lacking brood pouches (Mortensen, 1925). Material referred to both *P. laevigatus* and *P. leoninoides* requires revision.

Trachythyone macphersonae Pawson

Plates 4f, 5l–o

Trachythyone macphersonae Pawson, 1962: 47, pl. 1 figs 1–5.—Pawson, 1968b: 147–149, figs 12, 13.—Bennett, 1971, pl. 56 fig. 6b (upper figure is probably *P. laevigatus*).—Simpson, 1982: 48.

Material examined. Macquarie Island, Garden Cove, 26 Dec 1959, NMV F45001(holotype); Dec 1963, NMV F76116(4); 12 Aug 1962, NMV F76115(4); 25 Nov 1989, NMV F76114(1); 26 Nov 1989, NMV F76113(3); north coast, under rock in pool, Dec 1965, I. Bennett, ident. Pawson, NMV F45104(6); Buckles Bay, 8 Dec 1986, NMV F77777(1); off Buckles Bay, 54°30′S, 158°58′E, 15 m, 19 Oct 1983, NMV F82952(25); Aerial Cove, 28 Nov 1989, NMV F76110(5); 54°40′S, 159°01′E, 71 m, NZOI stn D10, NIWA(7). AM 1977–1978 Expedition, Tottan Head, Goat Bay (9–14 m), MA-369(1), MA-371(2), MA-376(2); Tern Rock Bay (1–10 m), MA-34(1), MA-35(6); Garden Cove (3–14 m), MA-92(5), MA-350(2), MA-354(18), MA-379(8); Sandy Bay (15–16 m), MA-237(5), 241(45), 242(4); Green Gorge (0.5–18 m), MA-245(4), MA-247(2), MA-248(7), MA-251(8), MA-267(2), MA-281(6), MA-292(1), MA-294(13); Caroline Cove (8–18 m), MA-300(4), MA-306(8), MA-307(1), MA-311(2); Handspike Point (intertidal), 136(4); Aerial Cove (0.5–6 m), MA-46(2), MA-47(8), MA-50(3), MA-83(13), MA-85(2), MA-98(1), MA-102(106), MA-108(26), MA-109(1), MA-110(10), MA-382(14), MA-386(261), MA-387(4), MA-388(18), MA-389(29); Anchor Rock (20 m), MA-89(13). ANARE 1986 Expedition, BT2, NMV F77773(6), BT3, NMV F77771(1), BT4, NMV F77772(3).

Description of material. Body (preserved) up to 65 mm long, 10 mm wide (AM stn MA-50). Body cylindrical, 10 short dendritic tentacles, orientated anteriorly, ventral pair reduced. Anus on small posterior cone or taper, surrounded by 5 small valves and some small tube feet. Scattered dorsal tube feet. Ventral tube feet slightly larger, restricted to radii, in 2 rows midventrally, and 1–2 rows ventrolaterally, rarely with 3 rows. Ventral skin thinner, distinct, no true sole. No tube feet on introvert. Juveniles (3 mm d.d.) with 1–2 tube feet on each ventral radius, few smaller tube feet scattered dorsally.

Dorsal ossicles massed flat perforated plates, overlain by cups. Small specimens have large plates to 0.3 mm long (rarely to 0.37 mm) with numerous knobs, up to 35 holes (pl. 5l). Knobs occasionally coalesce into incipient secondary layer. Plates often overlap to form rigid crystalline body wall. Large specimens with smaller plates, 0.06 to 0.23 mm long, with 2–13 holes, few small low knobs (pl. 5m, o). A few flat x-shaped ossicles present, possibly plate precursors. Cups oval-shaped with smooth cruciform base and spined rim, spines directed up away from cruciform piece (pl. 5m-o). Rim formed by coalescing ends of developing cruciform piece, typically to 0.05 mm long and 0.04 mm wide, slightly wider than deep. Cruciform pieces without rims or cups with incomplete rims sometimes found. Cups more numerous in adults. Ventral ossicles plates and cups, plates smaller, finer, more irregular than dorsal plates, 0.15 to 0.25 mm long. Introvert ossicles small thin plates with fine knobs and large perforations, to 0.25 mm long and 0.1 mm wide. Tube feet with endplates (0.3 mm dia) surrounded by a series of irregular narrow, bent or triangular perforated plates, typically 0.27 mm long 0.07 mm wide, sometimes with ends or 1 edge strongly denticulate. Tentacles with elongate curved knobbed perforated plates, typically 0.2 mm long and 0.04 mm wide, and smaller irregular perforated plates with large holes and few knobs, typically 0.07 mm long and 0.05 mm wide.

Reproduction. Sexes separate. Gonads a cluster of short tubules. Females with few relatively large eggs, typically 0.2 to 0.35 mm dia (Simpson, 1982 recorded eggs up to 0.8 mm dia.), eggs evident in specimens from all months sampled

(July to February), no evidence of brooding in the current specimens.

Colour. Body and introvert (live) pink or mauve; anal cone and tube feet light orange; tentacles dark orange with distinct brown dots at tentacle bases.

Habitat. Sublittoral, under rocks or sheltering amongst encrusting sponges, anemones or the green alga *Codium*, common within *Macrocystis* holdfasts. Locally numerous under sheltered rock overhangs.

Distribution. Macquarie Island (0.5–135 m).

Remarks. Many species of *Trachythyone* described from the Southern Ocean are ill-defined and require revision. The ossicles of the various species can change with age and some ossicle types may be missing from old or poorly preserved specimens. *T. macphersonae* is similar to material of *T. parva* described by Panning (1964) and Hernandez (1982) from off Chile and the Falkland Islands (0–180 m) and may be conspecific. Both species have knobbed plates and cups, with large plates (pl. 5l) and few cups in juveniles and smaller plates (pl. 5m, o) overlain by numerous cups in adults. Whether these specimens are conspecific with the types of *T. parva* is uncertain as Ludwig's (1875) inadequate description of the ossicles in the type translates as "large perforated plates" and "small x-shaped cups". Some specimens of *T. macphersonae* have a few incomplete x-shaped cups consisting only of the concave cruciform piece. Specimens from Kerguelen, originally recorded as *T. parva* by early workers, were redescribed as *T. ekmani* by Ludwig and Heding (1935) on the basis that they possessed cups instead of x-shaped plates. On the other hand Cherbonnier and Guille (1975) suggested that *T. ekmani* is no more than a ecological race of *T. parva*. Possibly *T. parva, T. ekmani* and *T. macphersonae* represent a single widely-dispersed subantarctic species. A revision will require fresh material of several size classes collected from throughout the subantarctic.

Trachythyone nelladana sp. nov.

Plates 4h–i, 5e–k, Figure 5a

Material examined. Holotype, Macquarie Island, ANARE 1986 Expedition, off Nugget Point, 54°33.4'S, 158°56.9'E, 108–135 m, 8 Dec 1986, stn BT3, NMV F83072.

Paratypes, type locality and date, NMV F77770(10).

Description. Holotype 10 mm long, 4 mm wide, 3 mm high. Body dome shaped with convex dorsal surface and flattened sole. Mouth orientated anteriorly, 10 dendritic tentacles, ventral pair reduced. Small thin introvert. Posteriorly orientated anus. No dorsal tube feet, except pair of minute ones at anterior margin. Sole present, surrounded by ring of about 25 large tube feet, tube feet denser near anterior and posterior ends, isolated midventral tube foot occasionally present, skin of sole very thin. No obvious anal or oral valves. Calcareous ring with 5 radial and 5 interradial pieces, each with incised anterior projection and posterior notch; radials larger with smaller anterior incision.

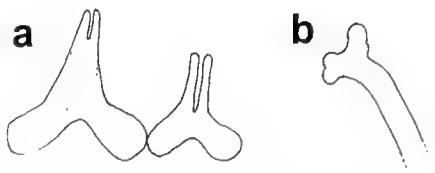

Figure 5. a, *Trachythyone nelladana*, NMV F77770, radial and interradial plate of calcareous ring. b, *Taeniogyrus* sp., AM J22904, tentacle ossicle fragment.

Dorsal ossicles consist of several layers of overlapping perforated plates overlain by cups. Plates up to 0.55 mm, approximately 30 plates between anus and introvert on largest specimen, up to 50 perforations per plate in regular arrangement (pl. 5e), no knobs, some larger plates with ventral thickenings or arches. Cups oval, with thick cruciform piece and spinose rim, typically 0.05 mm long, 0.04 mm wide, 0.04 mm deep, rim often incomplete (pl. 5h–j). Ventral ossicles small buttons with 2–8 large holes, margin with small rounded knobs, up to 0.1 mm dia (pl. 5f–g). Tube foot ossicles elongate perforated rods surrounding end plate, end plate 0.3 mm dia. Tentacle ossicles flat perforated plates, quadrangular, typically with 10 perforations and denticulate margin, to 0.12 mm; some plates slightly concave; other plates elongate, 3 times as long as wide, with larger perforations (pl. 5k).

Paratypes 4–11 mm in length, similar morphology and ossicles as holotype.

Colour. Tan/white, pale (preserved).

Reproduction. Female caeca in December with long slender unbranched moniliform tubules (one half the body length) containing scattered ovoid eggs 0.15 to 0.25 mm long.

Habitat. Unknown.

Etymology. Latinised form of the name of the former polar vessel *Nella Dan* from which these specimens were collected.

Distribution. Macquarie Island (108–135 m).

Remarks. These specimens are intermediate between the Psolidae and Cucumariidae having the clearly defined sole of a psolid (thin skin, mainly peripheral tube feet and small ventral ossicles) and the small single-layered plates, well-developed cups and terminal mouth/anus of a cucumariid. Both families contain species that lack dorsal tube feet. I am placing this species in the Cucumariidae on the basis of the ossicles present. However, the Cucumariidae is possibly paraphyletic, the psolids representing an extreme development of cucumariids with imbricating dorsal plates.

I am reluctant to create a new genus for these animals as the Cucumariidae is badly in need of revision and generic limits are unclear (O'Loughlin and O'Hara, 1992). The ossicles, flat imbricating plates and cups, are similar to those found in *Trachythyone* species. It is clearly distinguished from all other *Trachythyone* species in lacking dorsal pedicels. Species within the Cucumariidae that lack dorsal tube feet include *Ocnus farquhari* Mortensen, 1925 and *O. sacculus* Pawson, 1983 from New Zealand. These species differ from the *T. nelladana* in having multi-layered ossicles, knobbed buttons and rows of tube feet on all three ventral radii. Other cucumariid genera that lack dorsal tube feet include *Microchoerus* Gutt, 1990 which has small knobbed plates that diminish with age and lacks cups; *Neocnus* Cherbonnier, 1962 and *Pseudopsolus* Ludwig, 1898 which have few body wall ossicles.

The new species can be differentiated from species of *Psolus* by the terminal mouth and anus, the flat single-layered dorsal plates, the well-developed cup ossicles (absent in the sole), and the flat reduced ventral plates. Several other species have a similar body form, including *P. charcoti* Vaney, 1906, *P. murrayi* Théel, 1886, and *P. granulosus* Vaney, 1906 from the Southern Ocean. The body shape of *P. granulosus* is most similar to the current species. However, this species has multi-layered dorsal scales, knobbed ventral plates and lacks true cups. Both *P. charcoti* and P. *murrayi* are large cylindrical animals with a small sole and a thick epidermis that obscures the multilayered dorsal scales. Few *Psolus* species have true cup ossicles, their functional role often being replaced by multi-layered grains (e.g., *P. neozelanicus*) or concave spinous plates. *Psolus ephipiffer* Thomson, 1876 and *P. paradubiosus* Carriol and Féral, 1985 both from the Kerguelen region, have shallow cup-shaped ossicles, but differ from the current species in their body form, large dorsal scales and the knobbed ventral plates. *P. koehleri* Vaney, 1914 from the Antarctic Peninsula has shallow cups in the sole, but has an upturned oral cone, the mouth being surrounded by five brood sacs.

Order Apodida

Chiridotidae

Taeniogyrus dunedinensis (Parker)

Plates 4d, 5r–t

Trochodota dunedinensis Parker, 1881: 418. Dendy, 1896: 26–28, 49–50, pl. 3 figs 1–8.—Mortensen, 1925: 376–381, figs 59–61.—Pawson, 1968a: 24–25.—Pawson, 1970: 46–47 .—McKnight, 1984: 146.

Taeniogyrus dunedinensis.—Rowe, 1976: 204.

? *Trochodota* sp.—Pawson, 1968b: 149.

Taeniogyrus sp. nov.—O'Hara, 1998a: 146.

Material examined. Macquarie Island, shore, 1912, H. Hamilton (AAE), det. Pawson (1968b) as *Trochodota* sp., AM J4725(2); 54°40′S, 159°01′E, 71 m, NZOI stn D10, det. Pawson (1968a), NIWA(4). ANARE 1986 Expedition, BT4, NMV F77775(1).

New Zealand, Stewart Island, Paterson Inlet, 9 m, 12 Jan 1952, NMV F82702(4).

Description of Macquarie Island material. Up to 15 mm long. 10 uniform tentacles, approximately 8 digits per tentacle. Oral disc orientated obliquely. Skin smooth, not papillate, one specimen (BT4) with a few white spots in the anterior body wall formed from clusters of wheel ossicles. Calcareous ring plates narrow, quadrangular, with slight posterior notches.

Body wall ossicles wheels and sigmoid hooks. Wheels slightly hexagonal, up to 0.09 mm long, 6 spokes, continuous teeth around inner rim, 4 teeth across spokes, 5 teeth between spokes (pl. 5r). 1 specimen (BT4) with wheels grouped in anterior clusters, other specimens with sparse scattered wheels. Sigmoid hooks sparsely scattered, twice as long as wheels, to 0.16 mm long, smooth. Tentacle rods abundant (pl. 5t), to 0.12 mm, straight to curved to bent, not branched laterally, a few complex lateral knobs (pl. 5s), tips forked with 2 clusters of knobs.

Colour. Macquarie Island material (in alcohol) light brown. Live Auckland Island material reddish-brown with dark spots at the base of the tentacles (Mortensen, 1925).

Habitat. Auckland and Campbell Island specimens found under stones at low tide (Mortensen, 1925) and in shell/sand (Pawson, 1968a).

Distribution. New Zealand (1–9 m); Auckland, Campbell Islands (1–180 m); Macquarie Island (65–433 m).

Remarks. The present specimens differ from typical *T. dunedinensis* material from New Zealand in the relative size of the wheel and sigmoid hook ossicles, the wheels being considerably smaller than the hooks. However, the wheel ossicles are known to vary in size from 0.053 to 0.16 mm dia. in other material referred to *T. dunedinensis* (Mortensen, 1925). Without a large number of specimens it is impossible to determine whether the Macquarie Island material is conspecific with that from New Zealand.

Pawson (1968b) described two specimens of an undetermined *Trochodota* species collected by the ANARE expedition from the north coast of Macquarie Island. Unfortunately the ossicles have decayed, however, other characteristics suggest that it also belongs to this species. The specimens are 23 and 30 mm long, 1.5 mm wide, with ten subequal tentacles, eight digits per tentacle, the terminal digits are longest. The skin is not papillate and the mouth is orientated obliquely. The anterior half of the body of one specimen is filled with female gonads, the eggs are 0.3 mm dia.

Two other *Taeniogyrus* species occur in the Southern Ocean. *T. dendyi* (Mortensen, 1925) is known from northwest of the Auckland Islands (Pawson, 1968b). It is large in size (to 180 mm long), purple-white in colour, with 12–14 digits per tentacle. The skin is covered in papillae containing massed hooks, wheel ossicles are scarce, and the tentacle rods are small (0.05 mm) with 2–5 branches at each end. *T. contortus* (Ludwig, 1875) recorded from Kerguelen, has 12 tentacles, large sigmoid hooks, more than double the size of the wheel ossicles, and wheels that are grouped into distinctive papillae.

Taeniogyrus sp.

Plate 5u, Figure 5b

Material examined. Macquarie Island, AM 1977–1978 Expedition, Green Gorge (15 m), MA-289, AM J22904(3).

Description of Macquarie Island material. Up to 9 mm long (strongly contracted), in poor condition, with tapered anal cone. Skin with numerous longitudinal folds from contraction, probably papillose. Mouth orientated anteriorly, not oblique, 10 uniform tentacles, approximately 4 digits per tentacle, upper 2 largest. Body wall ossicles sigmoid hooks. Sigmoid hooks scattered, 1 per papillae, typically 0.07 to 0.11 mm long (pl. 5u). No wheels present. Tentacle ossicles mostly eroded, remaining pieces are rod ends with 3 terminal denticulations, entire ossicles probably 0.05 mm long (fig. 5b).

Colour. Tan in alcohol.

Habitat. Coarse sand.

Distribution. Macquarie Island (15 m).

Remarks. Chiridotids with sigmoid hooks but without wheel ossicles are generally referred to the genus *Scoliorhapis* H.L. Clark, 1928. However, although these small, poorly preserved specimens lack wheel ossicles they appear closer to *Taeniogyrus dendyi* (Mortensen, 1925) from New Zealand than the type species of *Scoliorhapis*, *S. theeli* (Heding, 1928) from southern Australia. Both species have groups of sigmoid hooks associated with skin papillae that are present on the anterior part of the animal. *S. theeli* clearly differs from the Macquarie Island material in having C-shaped unbranched tentacle ossicles, whereas wheel ossicles are known to be scarce or even absent in subantarctic specimens of *T. dendyi* (Mortensen, 1925, Pawson, 1968a). Better preserved material is required to finally determine the identity of these specimens.

Discussion

Habitat. Detailed habitat information is only available for Macquarie Island echinoderms collected from rocky shores (0–2 m) or by divers from shallow subtidal waters (0–25 m). The distribution of echinoderms across habitats at these depths is shown in Table 3. No quantitative survey has ever been conducted at subtidal depths at Macquarie Island. Consequently abundance has been estimated from museum collections.

1. Sublittoral fringe (0–2 m). The ecology and zonation of the rocky shores at Macquarie Island has been described by Kenny and Haysom (1962), Bennett (1971) and Simpson (1976). The sublittoral fringe is dominated by the large brown alga *Durvillaea antarctica*. This habitat which is affected by wave surge can range from 0–3 m on the east coast to as deep as 15 m on the exposed west coast (Ricker, 1984). Immediately seaward of *Durvillaea*, the rocks are covered with foliose red algae. A conspicuous but species-poor echinoderm fauna is present in the upper sublittoral, occurring under rocks, in crevices and under the large fronds of *Durvillaea*. Six echinoderm

Table 3. Known habitat distribution of Macquarie Island echinoderms (0–20 m). No habitat information is available for *Taeniogyrus dunedinensis*.

Species	Sublittoral fringe(0–2 m)		Upper sublittoral (2–20 m)			
	Durvillaea holdfasts	Red algal zone	*Macrocystis* beds	*Codium* beds	Rock overhangs	Sand
Cycethra frigida	?	P	P	P	P	-
Porania antarctica	-	-	R	-	-	-
Pteraster affinis	-	-	R	-	-	-
Henricia obesa	-	-	R	R	-	-
Smilasterias clarkailsa	-	-	-	R	R	-
Anasterias directa	R	P	P	P	P	-
Anasterias mawsoni	?	P	P	N	P	-
Ophiacantha vilis	-	-	R	-	P	R
Amphiura magellanica	-	-	P	-	-	-
Pseudechinus novaezealandiae	-	R	P	R	P	-
Pseudopsolus macquariensis	N	N	R	-	-	-
Pseudocnus laevigatus	-	R	P	P	N	R
Trachythyone macphersonae	-	P	P	P	N	-
Taeniogyrus sp	-	-	-	-	-	P

R = rare (all collections with <= 2 specimens); P = present (3–19 specimens); N = locally numerous (at least one collection with > 20 specimens)

species are generally present, the asteroids *Anasterias mawsoni, A. directa* and *Cycethra frigida*; and the holothurians *Pseudopsolus macquariensis, Trachythyone macphersonae* and *Pseudocnus laevigatus*. The first five of these may be abundant. In particular *P. macquariensis* may completely cover rocks at the low tide level. *P. laevigatus* is not common in this zone.

2. *Upper sublittoral* (2–20 m). Habitats at these depths have been described by Lowry et al. (1978) and Ricker (1984). The habitats include 1) exposed rocks and boulders dominated by a canopy of the kelp *Macrocystis pyrifera* often with an understorey of *Desmarestia chordalis*; 2) sheltered rock caves and overhangs covered with sponges, tunicates and hydroids; 3) protected shallow coves and inlets often with mats of the green algae *Codium subantarcticum*; and 4) areas of coarse sand and gravel. The asteroids and holothurians *A. mawsoni, A. directa* and *C. frigida, T. macphersonae* and *P. laevigatus* are common as in the sublittoral fringe, but *P. macquariensis* is rarely found below 1 m. Several shelf species are also present. The echinoid *Pseudechinus novaezealandiae* and the ophiuroid *Ophiacantha vilis* may be locally common. The asteroids *Henricia obesa, Smilasterias clarkailsa, Porania antarctica, Pteraster affinis*, the ophiuroid *Amphiura magellanica* and the holothurian *Taeniogyrus* sp. also reach their upper limit in this zone.

3. Deep water (< 20 m). The continental slope surrounding Macquarie Island is covered by very little sediment (Williamson, 1988). The slopes are very steep, the east side plunges over 5000 m from Macquarie Island to the Macquarie Trench in a little over 25 km. The total submerged area of the Macquarie Ridge occurring at depths of less than 1000 m deep is only 3300 km^2 (Williams, 1988). Most of the Macquarie Island material from deeper water has been trawled and lacks detailed substratum information. The lack of sediment indicates that many species would occur on rock or amongst sessile invertebrates growing on rock, although there are some species that are known from elsewhere to prefer a soft sediment substratum (e.g., *Psilaster charcoti, Taeniogyrus* spp.).

The echinoderm fauna is similar at all shallow water sites that have been examined around the island (Table 2) although relative abundance can vary with exposure (Bennett, 1971; Ricker, 1984). There are some exceptions. *Porania antarctica* and *Pteraster affinis* have been found by divers only at Caroline Cove despite the low level of sampling at the site. *Taeniogyrus* sp. was collected only at Green Gorge off a sandy substratum. Relatively few soft sediment species

have been found from 0–20 m. This may be due to the lack of suitable substratum or the lack of collecting with dredges and boats within this depth range (G.C.B. Poore, pers. comm.).

The shallow subtidal environment is broadly similar at other subantarctic Islands including Marion Island (Beckley and Branch, 1992; Branch et al., 1993), Heard Island (Smith and Simpson, 1985) and Kerguelen (Guille, 1974; Cherbonnier and Guille, 1975; McClintock, 1985), with the exception that the kelp *Macrocystis* is apparently absent from Heard Island. A similar echinoderm fauna is present at all locations. *Anasterias rupicola, Pseudechinus marionis* and *Pseudocnus laevi-gatus* dominate the echinoderm fauna at Marion Island, although the asteroid *Anteliaster scaber* and the ophiuroid *Ophiurolepis intorta* can be locally common. Other shallow water species include *Henricia praestens, Pteraster affinis, Porania antarctica* and *Smilasterias scalprifera*. There has been no subtidal SCUBA survey of Heard Island, but beach washed specimens indicate that the asteroids *Anasterias mawsoni, Odontaster meridionalis, Porania antarctica* and *Pteraster affinis* are common (O'Hara, this report). At Kerguelen shallow rocky reefs support *Anasterias rupicola* and *A. perrieri, Henricia spinulifera, Porania antarctica, Pteraster affinis, Cycethra frigida, Pseudopsolus macquariensis gruai, Pseudocnus laevigatus* and *Trachythyone ekmani*. Kerguelen differs from Macquarie Island in having wide sandy bays which support a significant soft sediment fauna.

Systematics and origin. One of the difficulties identifying echinoderms from Macquarie Island is the polymorphism exhibited by many species (or species complexes) that are widespread throughout the Southern Ocean. There is considerable morphological variation both between and within isolated populations. Examples of widespread polymorphic species include the asteroids *Odontaster penicillatus* and *Cycethra verrucosa* which can vary in form from subpentagonal to stellate with a range of abactinal spination. In other cases a number of discrete regional or sibling species are currently recognised, such as the numerous *Anasterias* and *Henricia* species. The current and past geography of the Southern Ocean is likely to have promoted regional variation and polymorphism. The break up of the ancient continent of Gondwana would have isolated populations of formerly widespread species, which could then have evolved independently (Palaeoaustral species). Examples include *Psolus neozelanicus* and *P. antarcticus*, very similar species that are now widely separated in the Tasman region and off South America respectively. Overlaying these vicariant patterns are species (Neoaustral species) that have subsequently dispersed eastward across the Southern Ocean by epiplanktonic rafting on the West Wind Drift (H.B. Fell, 1962). Infrequent colonisation of isolated islands would promote regional variation and speciation through founder effects and genetic drift (Palumbi, 1994). Polymorphism has possibly been accentuated by a complex process of colonisation, genetic drift and recolonisation by parental stock. Dispersal by epiplanktonic rafting is restricted to shallow water rocky reef species living amongst kelp holdfasts, the only known transportation vector (O'Hara, 1998a). Species rafting to Macquarie Island from the west probably include *Anasterias* spp., *Cycethra frigida, Trachythyone macphersonae, Pseudocnus laevigatus* and *Pseudopsolus macquariensis*, all of which have been found within kelp holdfasts on Macquarie Island.

The problem for a taxonomist is whether these morphological variants are separate species, subspecies or races. Key (1981) has provided some relevant definitions. Species are populations that are reproductively isolated from all others, where reproductive isolation requires that either no hybrids are found in the field or that such hybrids are infertile. A race is any population within a species that it is convenient to recognise on the basis of characteristic attributes. A subspecies is a special case of a geographical race which has been given a formal trinomial name under the terms of the International Code of Zoological Nomenclature.

The trend in echinoderm systematics over this century has been to synonymise regional forms into polymorphic widespread species. Early researchers, with relatively few specimens at their disposal, described numerous species differentiated by small morphological differences. As more comprehensive collections have become available, the distinction between these nominal species became blurred and many were synonymised or reduced to subspecies (e.g., Fisher, 1940; A.M. Clark, 1962). Later monographs have tended to abandon the use of subspecies as it becomes clear that the morphological variants are not confined to distinct regions (e.g., A.M. Clark and Downey, 1992). However sibling species are known to be common in marine systems

(Knowlton, 1993), and recent research indicates that morphologically similar echinoderm species can be distinguished using reproductive or molecular data (e.g., Bosch, 1989; Hart et al., 1997).

The approach in this work is to follow Key's (1981) recommendations not to designate new subspecific names and retain existing species names for regional variants until we have evidence to the contrary. Thus I have refrained from establishing new subspecies for Macquarie Island variants of *Henricia obesa* and *Odontaster penicillatus*. On the other hand I have retained the nominal species *Anasterias directa, Smilasterias clarkailsa* and *Trachythyone macphersonae* even though they are very close to *A. antarctica, S. scalprifera* and *T. parva* respectively. The final determination of whether these are distinct specific or infraspecific taxa will have to await developmental or molecular research as traditional external morphological characters appear insufficient to resolve the problem. Amongst the numerous pentamerous *Anasterias* species, only *A. studeri* and *A. suteri* can be adequately distinguished from *A. antarctica* on morphological grounds. Other species complexes requiring investigation are *Henricia pagenstecheri/ H. simplex/H. lukinsi* and *H. obesa/H. aucklandiae*. On a global scale *Pteraster affinis* is very close to *P. militaris* from the Arctic, and *Ceramaster patagonicus* is similar to *C. grenadensis* (A.M. Clark and Downey, 1992).

This report retains four species as Macquarie Island endemics: *Anasterias directa, Odontohenricia anarea, Trachythyone macphersonae,* and *Trachythyone nelladana*. In addition other poorly known species listed from Macquarie Island, such as *Ophiomyxa* sp. and *Taeniogyrus* sp. may also be endemic. However, in no case is the endemic status certain. *A. directa* and *T. macphersonae* are morphological variants of widespread Southern Ocean species, The poorly known species are likely to be regional variants of New Zealand or deep water species. Only *Odontohenricia anarea* and *Trachythyone nelladana* are completely distinct from their cogeners. Both are known from shelf habitats (69–135 m) and as such are likely to have migrated to the recently emergent Macquarie Island via the North or South Macquarie Ridge from New Zealand or eastern Antarctica respectively (O'Hara, 1998a). As such we can expect to collect these species in the future from nearby shelf or ridge localities. The lack of apparent speciation on Macquarie Island is a possible indication of the conservative evolution of echinoderms (H.B. Fell, 1962) or the continuing input of genetic material from neighbouring localities via epiplanktonic or larval dispersal (O'Hara, 1998a).

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NEW SPECIES OF THE WATER MITE GENUS *ARRENURUS* FROM EASTERN AUSTRALIA (ACARI: HYDRACHNIDIA: ARRENURIDAE)

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Abstract

Smit, H., 1999. New species of the water mite genus *Arrenurus* from eastern Australia (Acari: Hydrachnidia: Arrenuridae). *Memoirs of Museum Victoria* 57: 225–236.

Five new species of the water mite genus *Arrenurus* from Queensland, Victoria and Tasmania are described, viz. *A. acutipetiolatus* sp. nov., *A. maria* sp. nov., *A. hybridus* sp. nov., *A. queenslandicus* sp. nov and *A. perplexus* sp. nov. The name *Arrenurus mantonensis* Smit is preoccupied, and therefore the new name *Arrenurus bifurcatus* nom. nov. is proposed. *Arrenurus madaraszi* Daday is recorded for the first time from Australia. Some measurements, additional characters and new records are given for already known species.

Introduction

Of the cosmopolitan water mite genus *Arrenurus* 35 species and subspecies are known from Australia (Smit, 1997), a relatively low number compared to the 150 species from Europe (Smit, 1996). A key of all Australian species was provided by Smit (1997). In this paper five new species from Victoria, Tasmania and Queensland are described, and one new name is given to a previously described species. Additionally, one species new to the fauna of Australia is reported and some additional characters and measurements are given for already known species.

All material has been collected by the author. Victorian and Tasmanian holotypes and paratypes have been deposited in Museum Victoria, Melbourne (NMV), and in the Tasmanian Museum and Art Gallery, Hobart (TM) respectively. Holotypes and paratypes from Queensland have been deposited in the Queensland Museum, Brisbane (QM). Other paratypes and all non-type material have been deposited in the Zoological Museum of the University of Amsterdam (ZMAN).

The following abbreviations have been used (see figs 1, 2 and 6): A1 and A2, pre- and post antennal glandularia; C2–4, coxoglandularia 2–4; D1–4, dorsoglandularia 1–4; L1–4, lateroglandularia 1–4; V2, ventroglandularia 2; PI–PV, palp segments 1–5; IV-leg-4–6, fourth–sixth segments of fourth leg; NHRS, Swedish Museum of Natural History. For the description of the glandularia, Jin and Wiles (1996) and Wiles (1997) are followed. All measurements are in µm, measurements of leg and palp segments are of the dorsal margins. Measurements of paratypes in the description of new species are given in brackets. Scale lines are 200 µm for most figures and 50 µm for figures of the palp.

Arrenurus (Arrenurus) acutipetiolatus sp. nov.

Figures 1–6

Material examined. Holotype. Male, Victoria, swamp at junction of Victoria Valley Road and Bundol Road, SW of Grampians National Park, 30 Sep 1997 (NMV).

Paratypes: Victoria: 8 males, 22 females, same data as holotype (NMV, TM, ZMAN).

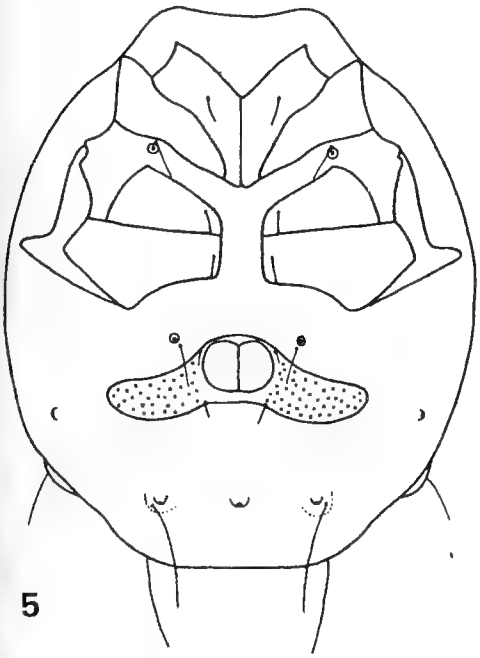
Tasmania: 14 females, Reservoir of Darlington, Maria Island National Park, Tasmania, 18 Oct 1997 (ZMAN).

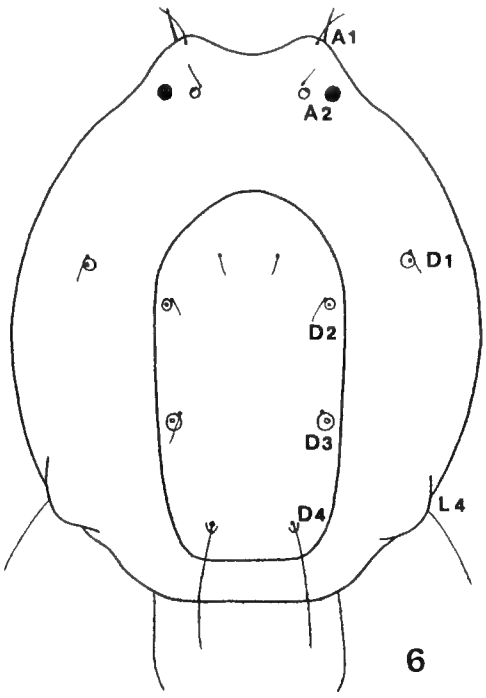
Other material. New South Wales: 1 female, Mt Victoria, 24 Oct 1936, leg. F. Linder (NHRS, slide 3414, *"A. fissipetiolatus"*).

Diagnosis. Petiole without ligulate process, narrowed posteriorly, with pointed extension. Female with L4 and V2 on small humps.

Description. Male: Body 1499 (1464–1584) in length and 1222 (1128–1248) in width. Body brownish. Anterior body margin concave. Body with well developed pygal lobes. Dorsal shield 601 in width, dorsal furrow incomplete. D1 on small humps, D3 on large humps. Setae associated with D4 on long tubercles. Genital plates

Figures 1–4. *Arrenurus acutipetiolatus.* 1, holotype male, dorsal view. 2, ventral view. 3, lateral view. 4, palp.





Figures 5, 6. *Arrenurus acutipetiolatus*. 5, paratype female, ventral view. 6, dorsal view.

straight, medially widened, extending to lateral body margin. Petiole posteriorly narrowed, with a pointed extension; ligulate process absent. Hyaline membrane well developed, with more or less pointed lateral angles, posteriorly concave. Setae associated with petiole extending beyond posterior margin of petiole. Lengths of PI–PV: 60, 130, 108, 149, 88; PII with 4 setae on medial side, of which 2 in anteroventral corner. Antagonistic bristle of PIV 106 long. Lengths of I-leg-4–6: 301, 262, 252. Lengths of IV-leg-4–6: 407, 204, 262; IV-leg-4 with a short spur. Second, third and fourth legs with numerous swimming setae.

Female: Body 1656 (1608–1992) in length and 1416 (1344–1764) in width. Anterior margin of body concave. Body truncated posteriorly, posterolateral corners present. Dorsal shield 1056 (1032–1344) in length and 563 (446-582) in width. Dorsal shield slender, usually widest in anterior part, slightly tapering posteriorly, posterior margin straight. Body shape and shape of dorsal shield variable, less truncated specimens can be found, as well as specimens in which the dorsal shield is contracted in middle or with parallel margins. L4 on small humps. Distance of fourth coxal plates larger than width of 1 genital valve. Medial margin of fourth coxal plates larger than medial length of third coxal plates. Gonopore 116 long. Gonopore without chitinized patches. Genital plates wide, slightly bowed. V2 on small humps. Lengths of PI-PV: 48, 132, 118, 144, 89. Palp as in male, antagonistic bristle of PIV 103 long. Lengths of I-leg-4–6: 281, 233, 242. Lengths of IV-leg-4–6: 349, 301, 267. Second, third and fourth legs with numerous swimming setae.

Etymology. The name refers to the pointed petiole.

Remarks. The new species is close to *A. fissipetiolatus* Lundblad. Both have an almost similar palp (long antagonistic bristle of PIV, 2–3 setae in anteroventral corner of PII). Males are easily distinguished by the shape of the petiole, but distinguishing the females is more difficult. Both have a rather slender dorsal shield, which character they share with *A. balladoniensis* Halík and *A. ensifer* Smit. The last species is the smallest, 1416 in length. *A. balladoniensis* is the largest, measuring 1848–2232 in length (Smit, 1997). *A. balladoniensis* can be told apart from *fissipetiolatus* and *acutipetiolatus* by the shape of the genital plate, which is much narrower than that of the last two species. *A. acutipetiolatus* differs from *A. fissipetiolatus* by having L4 on tubercles and a posteriorly more truncated body. Another useful

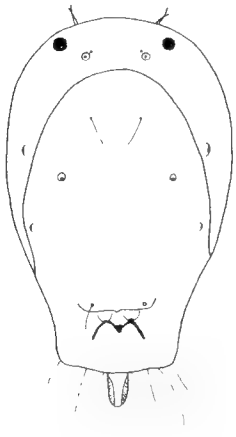
character by which to distinguish the two species is the shape of the dorsal shield, which is more slender in *acutipetiolatus*. The ratio length/width of the dorsal shield is 1.73–2.04 in *acutipetiolatus* (usually >1.80) and 1.50–1.67 in *fissipetiolatus*. Lundblad (1947) described the female of *A. fissipetiolatus*, but he had some doubts if the assignment to this species was correct, because the male and the female came from different locations. The female described by Lundblad matches the description of *A. acutipetiolatus* (L4 on humps, body truncated, ratio dorsal shield 1.89), and should therefore be assigned to that species.

Arrenurus (Arrenurus) hybridus sp. nov.

Figures 7–10

Arrenurus sp. — Harvey, 1998: 106, fig. 32C.

Material examined. Holotype. Male, Victoria, pond, Hospice Plain, Mt Buffalo National Park, 10 Oct 1997 (NMV).



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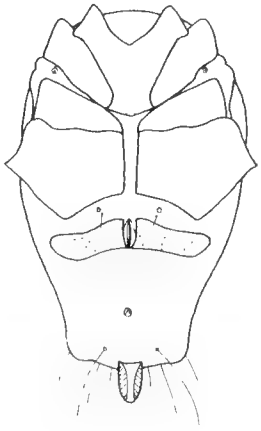

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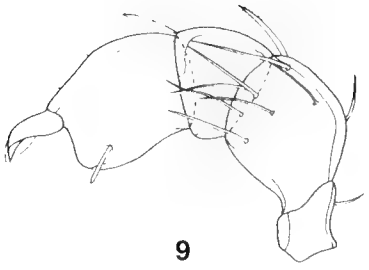

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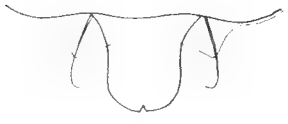

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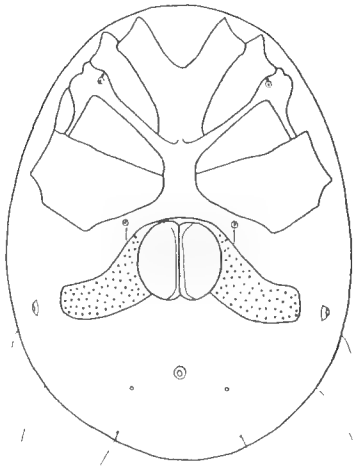

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Figures 7–10. *Arrenurus hybridus*, holotype male, 12, dorsal view, 13, ventral view. 14, palp. 15, paratype female, ventral view.
Figure 11. *Arrenurus fissipetiolatus* Lundblad, holotype male, detail of petiole.

Paratypes. Victoria: 1 male (ZMAN), 1 male (NMV), same data as holotype; 1 male (not sclerotized, ZMAN), 1 female (NMV), small ponds, Kowan Plain, + 1400 m above sea level, Mt Buffalo National Park, 10 Oct 1997.

Diagnosis. Body with distinct cauda. Petiole present, spatulate. Hyaline membrane and ligulate process absent.

Description. Male: Body 951 (912–951) long and 543 (504–553) wide. Anterior body margin rounded. Body posteriorly gradually tapering into a distinct cauda. Cauda with a shallow concavity. Dorsal furrow not closed posteriorly. Posterior margin almost straight, with small indentations. First coxal plates extending beyond anterior body margin. Second and third coxal plates lying very close. Gonopore 72 long. Genital field 197 long, not extending to lateral body margin, slightly undulating. Petiole spatulate, hyaline membrane and ligulate process absent. Lengths of PI-PV: 38, 82, 65, 91, 31; PII with 7 (8?) setae on medial side. Lengths of I-leg-4–6: 136, 136, 146. Lengths of IV-leg-4–6: 194, 184, 155. IV-leg-4 without spur, but IV-leg-5 with dorsodistal extension. Second, third and fourth legs with numerous swimming setae.

Female: Body 1106 long and 825 wide, egg-shaped, without posterolateral corners. Anterior body margin rounded. Dorsal shield 970 long and 679 wide, dorsal furrow closed. Medial lengths of third and fourth coxal plates of equal length, fourth coxal plates almost without posteromedial corner. Gonopore large, 165 in length; gonopore with indistinct sclerotized patches. Genital plates bowed, laterally somewhat rectangular. Lengths of PI-PV: 46, 98, 82, 108, 48; PII with 8 setae on medial side. Second, third and fourth legs with numerous swimming setae.

Etymology. The name refers to the somewhat intermediate position of the new species between the subgenera *Arrenurus* and *Megaluracarus*.

Remarks. No other Indo-Australian *Arrenurus* species has a distinct cauda with a spatulate petiole. The female is characterized by the combination of the absence of posterolateral corners, the absence of posteromedial corners of the fourth coxal plates and the medial margins of the third and fourth coxal plates being of equal length.

Arrenurus (Arrenurus) bifurcatus nov. nom.

Remarks. When describing *A. (Arrenurus) mantonensis* Smit, 1997, I was not aware of the existence of *A. (Megaluracarus) mantonensis* George, 1903. This species was synonymized by Viets (1956) with *A. buccinator* (Müller). Therefore, the species described by me is a junior homonym of *A. mantonensis* George and thus requires a new name for which I propose *Arrenurus bifurcatus* nom. nov. The new name refers to the bifurcated setae of the petiole.

Arrenurus (Arrenurus) fissipetiolatus Lundblad

Figure 11

Arrenurus (Arrenurus) fissipetiolatus Lundblad, 1947: 73, figs 46A D. — Cook, 1986, figs 1632–1637.

Material examined. Holotype. Male, Victoria, Maryborough, 24 Sept 1926, leg. E.J. Semmens (NHRS, slide 3413).

Other material. Victoria: 1 female, swamp at junction of Victoria Valley Road and Bundol Road, SW of Grampians National Park, 30 Sep 1997.

Tasmania: 1 male, 14 females, Blackmans Lagoon, Waterhouse Protected Area, 21 Oct 1997; 4 females, Little Waterhouse Lake, Waterhouse Protected Area, 21 Oct 1997.

Description. Male: Body 1488 (1337–1483) in length and 1272 (1064–1138) in width (in brackets the measurements of Lundblad, 1947 and Cook, 1986).

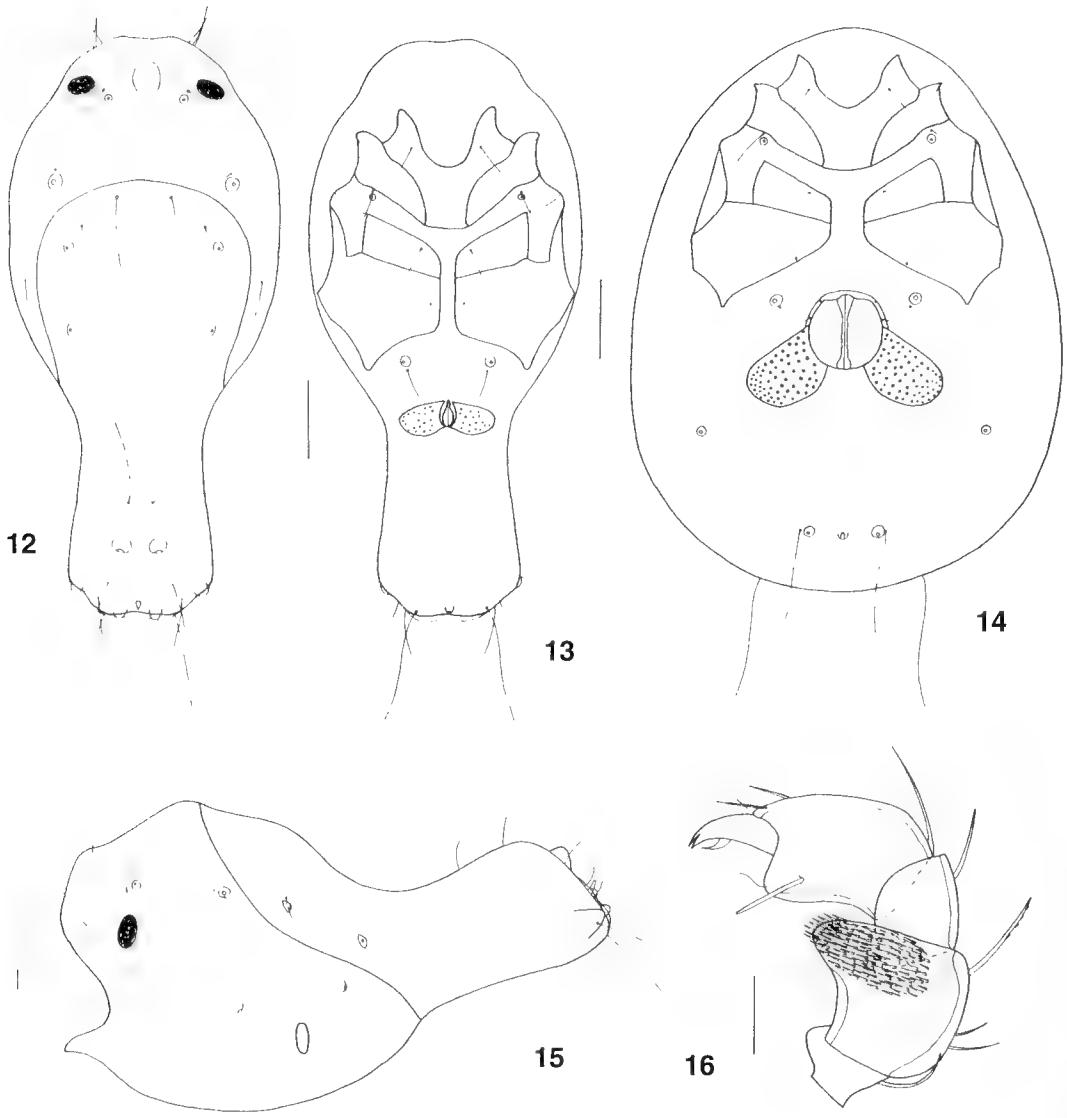
Female: Body 1680–1944 (Cook, 1986: 1581) in length and 1392–1656 (Cook, 1986: 1292) in width. Dorsal shield 1104-1320 in length and 281-364 in width; usually widest in middle. L1 shifted dorsally towards dorsal shield and therefore visible in dorsal view.

Remarks. Contrary to Lundblad's description, the male does not have a long spur. The holotype (Figure 16) and my own specimen have a notch in the posterior margin of the petiole. However, Cook (1986) could not observe this in all his specimens. The genital plate of most of my female specimens fit well with the description of Cook (1986). However, occasionally some specimens have a narrower genital plate, while others have a genital plate with a slightly undulating posterior margin. The species has been reported from Victoria and Tasmania. However, the number of specimens collected so far is very limited. Therefore, some additional characters and measurements are given. The female described by Lundblad (1947) belonged to another species (see under *A. acutipetiolatus*).

Arrenurus (Megaluracarus) maria sp. nov.

Figures 12–16

Material examined. Holotype. Male, Tasmania, reservoir of Darlington, Maria Island National Park, 18 Oct 1997 (TM).



Figures 12–16. *Arrenurus maria*. 7, holotype male, dorsal view. 8, ventral view. 9, lateral view. 10, palp. 11, paratype female, ventral view.

Paratypes. Tasmania: 1 female, same data as holotype (TM); 1 female, Apsley River, at crossing with Tasmanian Highway, 19 Oct 1997 (ZMAN).

Diagnosis. Male with a long cauda, posterior margin of cauda with a small hyaline area and 4 rounded hyaline extensions, 1 peg-like rudimentary petiole.

Description. Male: Body 1465 long and 708 wide. Anterior and posterior body part brownish, middle part bluish, cauda purple; legs bluish. Anterior body margin almost straight, body truncated anteriorly. In the middle between the eyes an area without body pores. Postocularia setae and setae associated with dorsoglandularia 2 and 4 very

long. Cauda much longer than wide, width of cauda 359. D4 on small humps. Posterolateral corners of cauda rounded. Cauda posteriorly with a distinct hyaline area and 4 rounded, hyaline extensions. Petiole rudimentary, peg-like. Genital field 252 in width. Genital plates short and rounded. Lengths of PI–PV: 24, 94, 62, 116, 53. PII with a large patch of setae lying on a bulge. Lengths of I-leg-4–6: 206, 243, 180. Lengths of IV-leg-4–6: 272, 184, 243; IV-leg-4 with a short spur. Second, third and fourth legs with numerous swimming setae.

Female: Body 1416 (1320) long and 1077 (1009) wide. Dorsal shield 897 long and 902 wide; dorsal furrow complete. Body brownish, posterior and anterior body parts purple; legs bluish. Between eyes an area without body pores. Body egg-shaped, without posterolateral or with indistinct posterolateral corners. Medial margin of third coxal plates larger than medial margin of fourth coxal plates. Medial distance of fourth coxal plates slightly smaller than width of 1 gonopore valve. Gonopore 194 long. Genital plates short and wide, sloping posteriorly, extending beyond posterior margin of gonopore. Lengths of PI-V: 36, 94, 67, 122, 50; palp as in male. Lengths of I-leg-4–6: 165, 204, 146. Lengths of IV-leg-4–6: 233, 272, 276. Second, third and fourth legs with numerous swimming setae.

Etymology. Named after the island where the type specimen was collected. Noun in apposition.

Remarks. The male of the new species is close to a number of Australian species with a long cauda, i.e. *A. otodus* Cook, *A. gilvus* Smit and *A. vanderpalae* Smit. The new species differs from *A. gilvus* and *A. vanderpalae* by its large size and the presence of only one peg-like rudimentary petiole (two in *gilvus* and *vanderpalae*), and from *A. otodus* by the lack of the pointed posterolateral corners of the cauda. Moreover, *A. maria* is larger than *A. otodus*, has a larger hump on which D4 are located, and its rounded hyaline extensions are not found in *A. otodus*. The female can be distinguished from all other species by having the medial margin of the third coxal plates larger than the medial margin of the fourth coxal plates.

Arrenurus (Micruracarus) forpicatoides Lundblad

Arrenurus (Micruracarus) forpicatoides Lundblad, 1941: 160. — Lundblad, 1947: 75, figs 47A–D. — Uchida and Imamura, 1951: 353, figs 18a–d. — Smit, 1992: 109.

Material examined. Victoria: 10 males, 21 females, swamp at junction of Victoria Valley Road and Bundol Road, southwest of Grampians National Park, 30 Sep 1997; 3 females, Lake Catani, Mt Buffalo National Park, 10 Oct 1997; 1 male, unnamed creek 4.5 km east of Shipwreck Creek, Croajingolong National Park, 23 Oct 1997.

Tasmania: 1 male, 2 females, old river branch of Coal River, north of Richmond, 17 Oct 1997; 1 female, swamp 12 km south of Gladstone, along road B82, 20 Oct 1997; 2 males, 10 females, Big Waterhouse Lake, Waterhouse Protected Area, 21 Oct 1997; 2 females, Little Waterhouse Lake, Waterhouse Protected Area, 21 Oct 1997.

Description. Male: Body 689–786 in length and 543–640 in width. Petiole occasionally reaching posterior body margin. Caudal lobes in some specimens rounded.

Female: Body 776-936 in length and 650-786 in width. Dorsal shield complete.

Remarks. The species was previously reported from Victoria, South Australia and Queensland. The specimens from Queensland reported by Smit (1992) do not belong to this species but to a new species described below. The record from China (Uchida and Imamura, 1951) needs confirmation as only females have been collected. Females of the subgenus *Micruracarus* with two pairs of rounded chitinized patches on the gonopore are difficult to identify. Moreover, the genital field of the specimens illustrated by Uchida and Imamura (1951) is laterally narrowed, a character not found in the Australian specimens.

Arrenurus (Micruracarus) queenslandicus sp. nov.

Figures 17–20

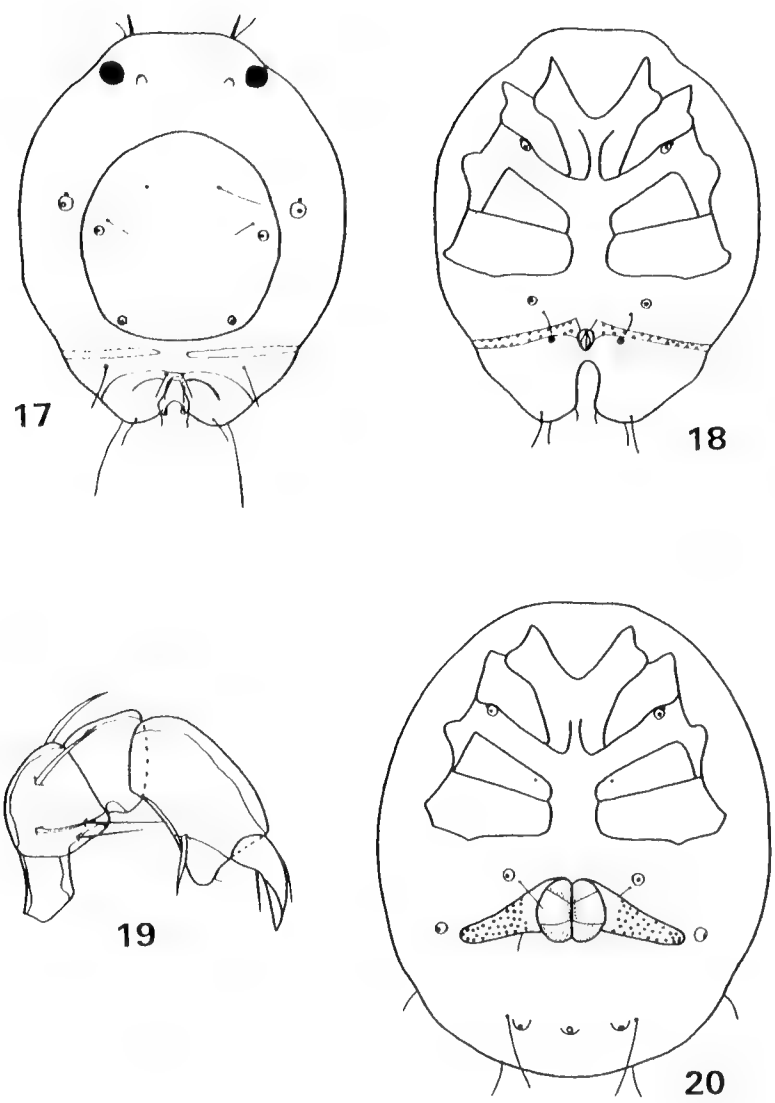
Arrenurus (Micruracarus) forpicatoides. — Smit, 1992: 109.

Material examined. Holotype. Male, Queensland, pond north of Normanton, 14 Aug 1989 (QM).

Paratypes. Queensland: 3 males, 5 females (QM), 3 males, 5 females (NMV), 3 males, 5 females (ZMAN), all same data as holotype; 3 males, 1 female (ZMAN), pond near Crocodile Road, Bowling Green Bay National Park, 31 Jul 1989; 3 males, 1 female (ZMAN), pond Townsville Common National Park, 1 Aug 1989; 1 male, Freshwater Lagoon, Horseshoe Bay, Magnetic Island, 3 Aug 1989.

Other material. Queensland: 2 females, pond north of Longreach, 15 Aug 1989.

Diagnosis. Cauda of male indistinctly set off from anterior part of body. Petiole tong-shaped, hyaline, fused with body by small hyaline area. Dorsal shield of female incomplete.



Figures 17–20. *Arrenurus queenslandicus*. 17, holotype male, dorsal view. 18, ventral view. 19, palp. 20, paratype female, ventral view.

Description. Male: Body 708 (660–795) in length and 611 (553–679) in width. Body yellowish brown to greenish. Anterior margin of body straight to slightly concave. Dorsal shield complete, 423 (359–456) in length and 417 (373–441) in width. Genital plates long and narrow, extending onto dorsum. Cauda indistinctly set off from anterior part of body. Cauda with median cleft. Petiole hyaline, tong-shaped, fused with body by a small hyaline area. Lengths of PI–PV: 31, 61, 40, 84, 50; PII with 4 setae on medial side, of which 2 close to ventral margin. Lengths of I-leg-4–6: 110, 113, 132. Lengths of IV-leg-4–6: 144, 134, 142; IV-leg-4 without a spur. Second, third and fourth legs with numerous swimming setae.

Female: Body egg-shaped, 951 (936–1048) in length and 786 (771–844) in width. Anterior body margin straight or slightly concave. Posterolateral corners of body almost absent. However, occasionally posterolateral corners more pronounced, and in these specimens body truncated posteriorly. Dorsal shield incomplete, 524 (495–572) in width. Medial distance of fourth coxal plates longer than width of 1 genital valve. Medial

margin of fourth coxal plates longer than medial margin of third coxal plates. Gonopore 98 long. Genital valves with large chitinous patches, anterior and posterior patches connected by chitinous strip. Genital plates straight to slightly bowed, tapering laterally. Lengths of PI-PV: 36, 70, 48, 89, 43; palp as in male. Lengths of I-leg-4–6: 130, 134, 125. Lengths of IV-leg-4–6: 155, 155, 136. Second, third and fourth legs with numerous swimming setae.

Etymology. The name refers to the state of Queensland in which the species has been found.

Remarks. I erroneously identified the species as *A. forpicatoides* (Smit, 1992). However, in the last species the cauda is distinctly set off from the body, the body is reddish brown and the tong-shaped part of the petiole is narrower. *A. anbangbang* Smit has a different shaped petiole which is not fused with the cauda. The female of the new species closely resembles *A. forpicatoides* but is larger, has a different colour and an incomplete dorsal shield.

Arrenurus (Micruracarus) perplexus sp. nov.

Figures 21–24

Material examined. Holotype. Male, Victoria, pond near Buckland River, at crossing with Buckland Valley Road (west of Bright), 11 Oct 1997 (NMV).

Paratype. Victoria: 1 female, same data as holotype (NMV).

Diagnosis. Cauda of male distinctly set off from body, lateral margin of cauda convex, body blue, petiole hyaline, tong-shaped. Body of female tapering posteriorly.

Description. Male: Body 635 long and 519 wide. Dorsal shield complete, 320 long and 320 wide. Body blue. Cauda distinctly set off from anterior part of body, lateral margins of cauda convex, caudal lobes rounded. Cauda posteriorly with a median cleft. D1 on small humps. Petiole hyaline, tong-shaped, fused with body by a small hyaline area. Genital plates narrow and long, extending onto dorsum. Lengths of PI-PV: 28, 50, 38, 72, 41; PII with 4 setae on medial side. Lengths of I-leg-4–6: 98, 94, 113. Lengths of IV-leg-4–6: 132, 125, 108; IV-leg-4 without spur. Second, third and fourth legs with numerous swimming setae.

Female: Body 757 long and 630 wide. Dorsal shield complete, 582 long and 432 wide; dorsal shield somewhat tapering posteriorly. Body tapering posteriorly, slightly truncated. Anterior margin of body straight. Medial distance of fourth coxal plates slightly larger than 1 genital valve. Medial margin of fourth coxal plates larger than medial margin of third coxal plates. Gonopore 97 long, each valve with 2 rounded chitinous patches. Genital plates straight, slightly sloping posteriorly and laterally somewhat enlarged. Lengths of PI-PV: 31, 55, 41, 86, 43. Palp as in male, but medial side of PII with 3 setae. Lengths of I-leg-4 6: 121, 125, 120. Lengths of IV-leg-4–6: 170, 156, 130. Second, third and fourth legs with numerous swimming setae.

Etymology. The name refers to the complicated structure of the petiole.

Remarks. The new species is close to *A. forpicatoides*, but differs in size, body colour and shape of the cauda. The hyaline petiole of the two species are nearly identical, although the tong-shaped part of the petiole is narrower in the new species. In *A. queenslandicus* the cauda is not set off from the body, but the petioles of the two species are very similar. The female of *A. perplexus* can be distinguished from *A. forpicatoides* by the body colour, shape of the body and the broader genital plates, and from *A. queenslandicus* by the complete dorsal shield.

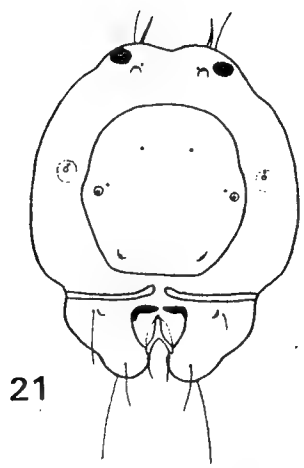
The species of *Micruracarus* with a hyaline petiole form a complex group within the genus *Arrenurus*. In my material (from Hasties Swamp, Atherton Tablelands, Queensland) another species might be present, of which the only male is somewhat intermediate between *A. queenslandicus* and *A. perplexus*. There are differences in shape of the cauda and the body between this male and the males of the two aforementioned species. Unfortunately, all three females from this location are different, and I refrain from describing it as a new species until more material is available.

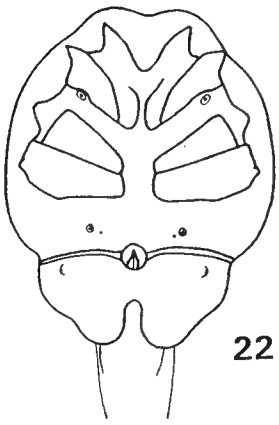
Arrenurus (Micruracarus) madaraszi Daday

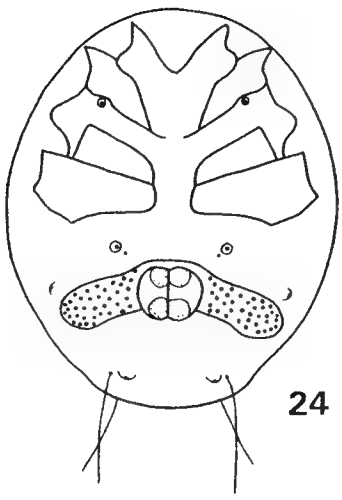
Arrenurus Madarászi Daday, 1898: 99, figs 49a i.
Arrenurus (Micruracarus) forpicatoides. Smit, 1992: 109 (part).

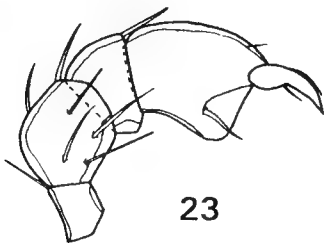
Material examined. Queensland: 1 male, pond in Townsville Common National Park, Queensland, 1 Aug 1989 (ZMAN).

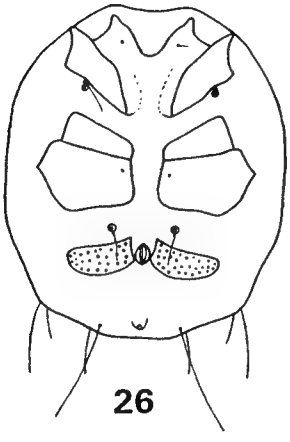
Remarks. Initially, the specimen has been identified erroneously as *A. forpicatoides* to which it is closely related. *A. madaraszi* is a very widespread species, known from Japan, China, Burma, India, Sri Lanka throughout Indonesia. This is the first record for Australia.

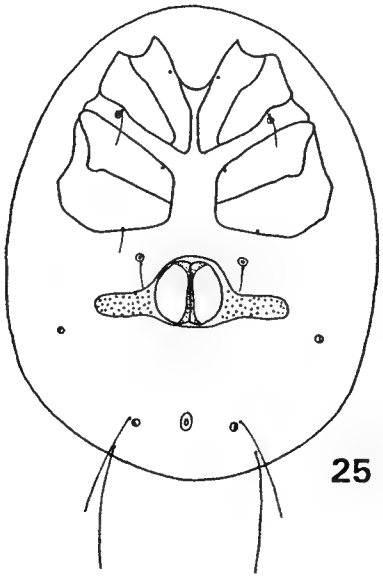












Figures 21–24. *Arrenurus perplexus.* 21, holotype male, dorsal view. 22, ventral view. 23, palp. 24, paratype female, ventral view.
Figure 25. *Arrenurus haswelli* Cook, ventral view female.
Figure 26. *Arrenurus novaehollandiae* Lundblad, ventral view male.

Arrenurus (Truncaturus) haswelli Cook

Figure 25

Arrenurus (Truncaturus) haswelli Cook, 1986: 309, figs 1653–1658, 1660.

Material examined. Holotype, Male, Tasmania, pond on southwest side of Great Lake, 18 Mar 1981 (NMV, slide K705). Paratype, female, same data as holotype (NMV, slide K706).

Other material, Tasmania: 7 males, 13 females, wetland south of Derwent River, 10 km east of New Norfolk, 17 Oct 1997 (ZMAN).

Description. Male: Body brownish. Males 757–834 in length and 485–533 in width.

Female: Body yellowish-brown to reddish-brown.

Remarks. Males in the series collected by me are smaller than the males of the type series, which measured 897–927 in length and 593–616 in width (Cook, 1986). Otherwise, males from this study fit well in the description of Cook. The females in my collection differ in a number of characters from females of the type series. Genital plates are much narrower as illustrated by Cook (1986). Moreover, the medial length of the fourth coxal plates is of equal length or smaller than the medial length of the third coxal plates (Figure 25). In the paratype female the medial lengths are more or less of equal size. The females from this study measure 960–1140 in length and 757–883 in width. As in the males, the females of this study are smaller than the type series.

So far, the species was only known from few specimens from the type locality, which is situated in Tasmania as well. The variation in genital plates is not unusual in female *Arrenurus* species (Smit, 1995). Because of this, and the fact that the males in my collection fit very well in the description of Cook (1986), all females are assigned to *A. haswelli*.

Arrenurus (Truncaturus) novaehollandiae Lundblad

Figure 26

Arrenurus (Truncaturus) novaehollandiae Lundblad, 1947: 79, figs 50A–D.

Material examined. Tasmania: 2 males, 7 females, reservoir of Darlington, Maria Island National Park, 18 Oct 1997 (ZMAN).

Description. Male: Body brownish. Body 771–786 in length and 640–645 in width. Genital plates wide, slightly bowed.

Female: Body colour as in male. Body 849–980 in length and 713–805 in width.

Remarks. Tasmanian specimens differ in colour and size from the type series but apart from this fit well with the description of Lundblad (1947). Specimens of the type-series are yellow-green and smaller. The species has only been reported from Victoria.

Acknowledgements

I am indebted to the Department of Natural Resources and Environment (Melbourne) and the Parks and Wildlife Service (Hobart) for permission to collect water mites in the national parks of Victoria and Tasmania respectively, to Dr T. Kronestedt for the loan of type material of *Arrenurus fissipetiolatus* and *A. australicus* and to Dr K. Walker for the loan of type material of *A. haswelli*. Johannes Postma (Ann Arbor) corrected the English.

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Memoirs of Museum Victoria 57(2): 237–239 (1999)

A SECOND SPECIES OF *ATRIPLECTIDES* MOSELY FROM AUSTRALIA (TRICHOPTERA: ATRIPLECTIDIDAE)

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Abstract

Neboiss, A., 1999. A second species of *Atriplectides* Mosely from Australia (Trichoptera: Atriplectididae). *Memoirs of Museum Victoria* 57: 237–239.

Atriplectides ikmaleus sp. nov. is described from the North Queensland Wet Tropics Heritage Area. Its adult and larval features are compared with those of several recently described neotropical atriplectidid ines.

Introduction

Investigation of the North Queensland Wet Tropics Heritage Area (Walker et al., 1993; 1995) revealed many undescribed species of Trichoptera which were given code-numbers pending formal species description. This material included a small number of specimens of *Atriplectides dubius* Mosely from several localities, as well as an undescribed *Atriplectides* species (code-number PT-2010).

Atriplectides dubius, hitherto the only Australian atriplectidid species known, is widely distributed and has been collected from numerous localities. It was described from Tasmania and subsequently found to be common throughout eastern Victoria and New South Wales. It has been recorded from Queensland as far north as the Mareeba district north of Cairns. It has been taken on Kangaroo Island and in the Adelaide Hills, South Australia, and from southwestern Western Australia. The single Western Australian specimen (Seldom Seen Brook, Jarradale, S. Bunn, 4.xi.1983, NMV collections) is marginally smaller than the average specimens from eastern Australia but shows no structural differences. The new species differs in wing and genitalic features; it overlaps the northern distribution of *A. dubius*.

Specimens were prepared for examination by clearing the abdomens in cold KOH solution. The dissected and figured specimens are identified by the author's notebook number with the prefix 'PT-'. Material is deposited in the Australian National Insect Collection, Canberra (ANIC) and Museum Victoria, Melbourne (NMV).

Atriplectides ikmaleus sp. nov.

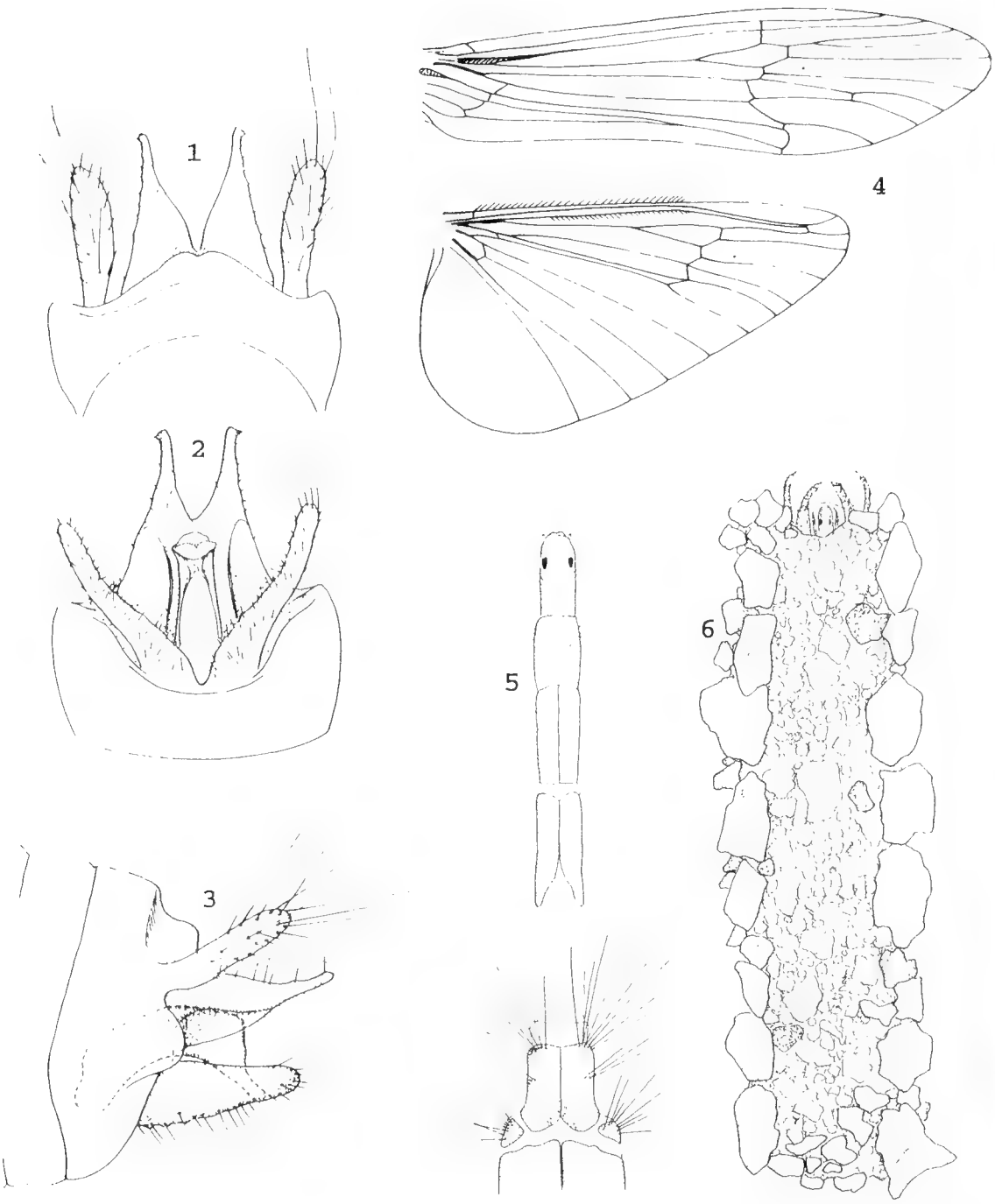
Figures 1–4

Material examined. Holotype male, North Queensland, Upper Mulgrave river via Gordonvale, 17°10′S, 145°53′E (Wet Tropics Investigation area 5), 29-30.iv.1970, S.R. Curtis, ANIC (genitalic prep. PT-2010, illustrated).

Paratype male, North Queensland, Yuccabine Creek, Kirrama State Forest, 18°12′S 145°54′E (Wet Tropics Investigation area 9), xii.1985, R. Pearson & L. Benson, NMV T17263 (genitalic prep. PT-1588).

Diagnosis. Forewing length 15.2–15.4 mm, slightly larger than *A. dubius*. Forewing fork 1 with footstalk short; cross-vein r-m at about distal third of discoidal cell; a small cross-vein between M1+2 and M3+4 about halfway between arculus and wing margin; male genitalia with single-segmented inferior appendages.

Description. Male. Wings (Fig. 4) fuscous without mottling (both specimens preserved in alcohol and faded, paratype male slightly teneral). Forewing fork 1 with short footstalk, fork 2 long, broadly sessile; an unusual cross-vein between M1+2 and M3+4 halfway between arculus and wing margin; hind wing Sc joins R1 shortly before wing margin, and at this point small cross-vein connects to R2+3; discoidal cell elongate triangular. Antennae slender, scape short, distinctly bulbous; segment 2 very short, slightly thicker than segment 3, subsequent segments long and slender. Maxillary palpi 5-segmented, first three segments more robust than distal segments, elongate; segments 4 and 5 distinctly thinner.



Figures 1–4. *Atriplectides ikmaleus* sp. nov. 1–3, male genitalia, dorsal, ventral and lateral views; 4, wing venation.
Figures 5, 6. *Atriplectides* sp. (presumably *ikmaleus*). 5, head and thorax, dorsal view; 6, larval case, dorsal view.

Genitalia (Figs 1–3). Abdominal segment IX short, lateral margins slightly lobose; segment X with a deep V-shaped cleavage separating rather slender, triangular, distally tapered lobes. Superior appendages slightly shorter than segment X, stout, rounded distally. Inferior appendages single-segmented, slightly compressed laterally, divergent distally, shorter than segment X. Phallus short, truncate, apically a distinct lip.

Female. Unknown.

Etymology. Latinised from *ikmaleos*, Greek — damp, wet — in reference to the wet tropical environment of the North Queensland World Heritage Area

Remarks. Atriplectides ikmaleus adults are known from only the two North Queensland localities, 150 km apart. The new species is distinguished from *A. dubius* by being larger (forewing 15.2–15.4 versus 12–14 mm), wing venation and the single-segmented inferior appendages of the male genetalia.

Two larval specimens are assigned to this species, collected from the same general area as the paratype (Yuccabine Creek, Kirrama State Forest, x.1983, R. Pearson & L. Benson, NMV). They are figured and keyed out as 'Species AV1' in the *'Preliminary keys ..... Atriplectididae, etc.'* by John Dean (in litt.). The sand-grain case (Fig. 6) is broad, dorsoventrally flattened with larger ballast particles attached along the lateral margins. The larva (Fig. 5) is distinguished from that of *A. dubius* (Neboiss, 1978) by the presence of five sclerites on the anterior half of the pronotum; and the hind tarsal claw less than half the length of the tarsus. The number and position of the gills resemble the arrangement in an unidentified Brazilian atriplectidid larva described and figured by Holzenthal (1997) as does also the curiously elongate arrangement of the pronotum, strengthened by additional sclerites. A similar prothoracic arrangement was described by Marlier (1978: 43) in an ondontocerid larva, *Hughscottiella auricapilla* Ulmer, from the Seychelles. This larva differs, however, in having strongly enlarged midlegs and its species was transferred to Atriplectididae by Neboiss (1978: 67).

The Atriplectididae were recently recorded from the Neotropics for the first time by Holzenthal (1997) who erected a new genus, *Neoatriplectides*, for a species from Peru, Bolivia and Ecuador (*N. froehlichi* Holzenthal). *Neoatriplectides* is characterised by the single-segmented inferior appendages of the male, a feature also seen in the new Australian species. However, the wing venation of the Australian species differs from that of the Neotropical genus.

Acknowledgements

My sincere thanks are extended to Mr John Dean, Melbourne, for providing the informative details of the larvae and giving permission to use his illustrations, and to Dr Alice Wells, Canberra, for continuous encouragement, discussions and help in the preparation of this manuscript.

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A NEW GENUS OF SUBCORTICAL COCCOIDS (HEMIPTERA: COCCOIDEA: ERIOCOCCIDAE) ON *EUCALYPTUS*

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Abstract

Gullan, P.J., 1999. A new genus of subcortical coccoids (Hemiptera: Coccoidea: Eriococcidae) on *Eucalyptus*. *Memoirs of Museum Victoria* 57: 241–250.

A new genus of Eriococcidae (Hemiptera: Coccoidea), *Subcorticoccus* gen. nov., is described for three new species of scale insects collected under eucalypt bark in southeastern Australia. *S. beardsleyi* sp. nov. occurs on *Eucalyptus macrorhyncha* near Melbourne, Victoria, whereas both *S. huonamnis* sp. nov. and *S. murrindindi* sp. nov. feed on *E. regnans* in Tasmania and Victoria, respectively. The adult females of all three species and the first-instar nymph of *S. beardsleyi* are described and illustrated. *Subcorticoccus* appears to be morphologically most similar to the Australian genus *Phacelococcus* Miller.

Introduction

The Eriococcidae are a speciose family of scale insects with major radiations in North and South America (e.g., Miller and Gonzalez, 1975; Miller and McKenzie, 1967; Miller and Miller, 1992), New Zealand (Hoy, 1962) and Australia (e.g., Froggatt, 1921; Hoy, 1963; Gullan, 1984). Except for the gall-inducing taxa, Australia's eriococcids have been poorly studied since the pioneering work of Froggatt (1921). It is thus not surprising that current taxonomic and cladistic studies of the Australian Eriococcidae are revealing a number of new taxa. In particular, one undescribed taxon exhibits unique morphology which appears most similar to that of *Phacelococcus* Miller. This taxon is represented by three undescribed species all of which were collected under *Eucalyptus* bark in southeastern Australia.

The adult females of these three new species differ from those of the speciose and cosmopolitan genus *Eriococcus* Targioni-Tozzetti and related genera in lacking anal lobes, enlarged dorsal setae, differentiated marginal setae and microtubular ducts, and in possessing a ventral, noncellular anal ring. They resemble *Phacelococcus* (Miller, 1970; Gullan and Strong, 1997) in possessing clusters of quinquelocular pores on the ventral abdomen and in having very small legs but differ in lacking anal lobes and microtubular ducts, and in having ventral frontal lobes, a mediolongitudinal band of microtrichia on the anterior dorsum and a single pair of anal ring setae on a simple anal ring. *Phacelococcus* and the undescribed species also share the habit of living under the bark of their eucalypt hosts. All of these species have been collected only rarely probably because of their cryptic habit and yet they may form an important dietary component for a number of other arboreal animals including mammals (Gullan and Strong, 1997) and arthropods. Since no observations are available on live specimens of the new species it is not known whether nymphs and adult females produce honeydew. The biology of these eriococcids warrants further study.

This paper erects a new genus, *Subcorticoccus*, for these three new species collected under eucalypt bark in southeastern Australia. The adult females of *S. beardsleyi* sp. nov., *S. huonamnis* sp. nov. and *S. murrindindi* sp. nov. and the first-instar nymph of *S. beardsleyi* are described and illustrated. The terminology and the slide-mounting and illustrative techniques employed are the same as those in Gullan and Strong (1997) except that the antennal sensilla are named according to Koteja (1980) and Le Rü et al. (1995). Thus trichoid sensilla are equivalent to the antennal hair-like setae mentioned in most other coccoid descriptions and the different types

of pegs have been variously called 'fleshy setae' or 'antennal bristles' by most previous authors; the antennal basiconic and coeloconic sensilla (which can be difficult to distinguish) and the campaniform sensillum usually are not mentioned in descriptions of coccoids.

Material is deposited in The Australian National Insect Collection, CSIRO Entomology, Canberra ACT, 2601, Australia (ANIC); The Natural History Museum, London SW7 5BD, UK (BMNH); Bernice P. Bishop Museum, Honolulu, Hawaii, USA (BPBM); and Museum Victoria, Melbourne, Victoria, Australia (NMV).

Subcorticoccus gen. nov.

Type species. Subcorticoccus murrindindi sp. nov.

Description. Adult female with abdomen tapering to rounded apex; derm membranous with rugulose microsculpturing, especially obvious marginally, and distinctive, mediolongitudinal band of microtrichia on dorsum of head and anterior thorax and much shorter band or indistinct cluster of microtrichia ventrally between antennae; pair of eyespots on body margin; antennae 6–7 (rarely 5) segmented, segments II to apical one subequal in length; 0–4 trichoid sensilla per antennal segment, lengths and distribution on segments variable but apical segment always with 2–4 sensilla, 20–35 μm long, and segment IV (or V if 7 segments) always lacking trichoid sensilla; pegs 5–25 μm long on antennal segments IV–VI (V–VII if 7 segments), distributed as follows: 1 on IV (or V), 1 on V (or VI), usually 3 on VI (or VII); usually 2 either basiconic or coeloconic sensilla, 5–12 μm long, only on apical segment (VI or VII); pair of oval, slightly raised, frontal lobes with rugulose surface, posteromedial to antennae; labium conical, width equal or greater than length, segmentation not apparent, segments possibly fused; legs reduced, less than 160 μm long; digitules of tarsi and claws capitate; tarsal claws with or without small denticle near apex; anal lobes completely lacking, their position indicated by pair of apical seta, one on each side of abdominal apex; anal ring ventral, simple, noncellular, usually with one flagellate anal ring seta (7–18 μm long) laterally on each side of ring and pair of flagellate suranal seta (8–20 μm long) just outside ring; dorsal setae short (4–16 μm long) and flagellate, in segmental rows, enlarged setae absent; ventral setae flagellate, longest (13–33 μm) near vulva; remainder similar in length to dorsal setae; differentiated marginal setae absent; slender macrotubular ducts, 10–16 μm long, 1–2 μm wide, present on dorsum and venter, scattered in bands across segments and in clusters on body margin, each duct with delicate inner filament (= ductule) with terminal knob barely distinguishable; microtubular ducts absent; multilocular pores mostly quinquelocular, very occasionally trilocular especially near spiracles, 3–6 μm in diameter, distributed in bands on ventral posterior abdomen and sometimes also scattered on margins of body, small clusters at opening of spiracles; bilocular pores absent.

Etymology. The genus name is descriptive of the under-bark habit of the species (*sub*, meaning under, Latin; *corticis*, meaning bark, Latin).

Comments. Adult females of *Subcorticoccus* can be distinguished from those of other Australian genera of Eriococcidae by the combination of a tapered abdomen, a mediolongitudinal band of microtrichia on the head and anterior thorax, a pair of oval frontal lobes, very small legs relative to the size of the body, a ventral and noncellular anal ring, all body setae flagellate and mostly less than 15 μm long, very slender macrotubular ducts distributed over both dorsum and venter, ventral bands of clustered quinquelocular pores on the posterior abdomen and sometimes scattered quinquelocular pores on the body margin, and the absence of anal lobes and microtubular ducts.

First-instar nymphs and a single prepupal male are known only for *S. beardsleyi* sp. nov. The male nymph is too poorly preserved to describe adequately.

Key to adult females of *Subcorticoccus*

1. Antennae usually 7 (rarely 6) segmented; legs of typical form but reduced in size; quinquelocular pores densely scattered around margins of entire body... ..... *S. murrindindi* sp. nov.
   Antennae usually 6 (rarely 5) segmented; legs highly reduced so that combined femur, tibia, tarsus and claw resembles an elongate cone; quinquelocular pores either absent from margins of body or sparsely scattered on abdominal margins 2

2. Quinquelocular pores sometimes present on margins of body, at least on abdomen, in dense bands ventrally on last 4 abdominal segments (V–VIII) plus a few pores on IV ..... *S. huonamnis* sp. nov.
— Quinquelocular pores absent from margins of abdomen, in sparse bands ventrally on last 4 abdominal segments (V–VIII) only ..... *S. beardsleyi* sp. nov.

Subcorticoccus beardsleyi sp. nov.

Figures 1–2

Type material. Holotype: adult female (1.6 mm long, largest of 3 females on slide), Victoria, near Heathcote, 15 Mar 1972, ex *Eucalyptus macrorhyncha*, under twig bark, J.W. Beardsley (ANIC)

Paratypes: 17 adult females (11 slides), 1 prepupal male (on slide with 2 adult females) and 4 first-instar nymphs (each on slide with 1 or 2 adult females), same data as holotype (2 slides in ANIC, 8 slides in BPBM, 1 slide in NMV T-17318).

Description of adult female (measurements based on 10 slide-mounted specimens) (Fig. 1). Body 1.1–1.7 mm long, 0.6–1.0 mm wide; segmentation distinct only on posterior half of abdomen. Eyespots 10–15 µm wide. Antennae (Fig. 1a) 43–70 µm long, with 6 (rarely 5) segments. Frontal lobes irregularly oval, each 30–80 µm long, 25–50 µm wide. Labium 50–70 µm long, 60–70 µm wide across base. Clypeolabral shield 120–170 µm long, 105–140 µm maximum width. Spiracles (Fig. 1c): mesothoracic 35–56 µm long, 14–25 µm wide; metathoracic 39–60 µm long, 14–27 µm wide. Legs (Figs 1b,d) 45–65 µm long, with segments highly reduced; tarsal digitules 8–20 µm long; claw digitules 8–15 µm long; claw denticle not discernible. Apical setae 20–40 µm long; anal ring (Fig. 1g) 14–20 µm in diameter with 1 pair of anal ring setae 8–10 µm long; suranal setae (Fig. 1g) 8–10 µm long.

Dorsum with mediolongitudinal band of microtrichia (Fig. 1h) on head and anterior thorax 140–260 µm long, widest (25–33 µm) posteriorly; flagellate setae, 4–10 µm long, sparsely distributed across all segments, longest on posterior abdominal segments; macrotubular ducts (Fig. 1e) 10–16 (mostly 13) µm long, 1–2 µm wide, scattered across all segments; quinquelocular pores absent.

Venter usually with a few microtrichia in indistinct cluster between antennae; flagellate setae 3–12 µm long, sparsely distributed across all segments, a pair of longer setae (13–18 µm) near vulva; macrotubular ducts (Fig. 1e) 10–14 (mostly 13) µm long, 1–2 µm wide, scattered across all segments; quinquelocular pores about 5 µm in diameter (Fig. 1f) in sparse bands on abdominal segments V to VIII, absent from margins of body, a small cluster of 3–8 pores (mostly quinquelocular, rarely trilocular) (Fig. 1e), each 3–4 µm in diameter, at opening of each spiracle and a few in each spiracular furrow.

Description of first-instar nymph (measurements based on 4 slide-mounted specimens) (Fig. 2). Body 0.32–0.41 mm long, 0.11–0.14 mm wide; segmentation indistinct; microtrichia absent. Eyespots 7–8 µm wide. Antennae 75–80 µm long, with 6 segments; trichoid sensilla 8–30 µm long, distributed as follows: 3 on I, 2 on II, 2 on III, 0 on IV, 2 on V, 3 on VI; pegs 4–13 µm long, distributed as follows: 1 on IV, 1 on V, 3 on VI; 3–4 basiconic or coeloconic sensilla, 5–6 µm long, on VI; a single campaniform sensillum on apical part of II. Labium conical, segmentation not apparent, 35–43 µm long, 30–34 µm wide across base. Clypeolabral shield 75–90 µm long, 42–50 µm maximum width. Spiracles about 10 µm long, 5–7 µm wide. Legs of typical form; tarsal digitules capitate (Fig. 2b), 15–25 µm long; claw digitules capitate, 10–15 µm long; each claw with small denticle near apex. Anal lobes absent; apical setae 52–60 µm long; anal tube, about 10 µm long, with simple, ventral anal opening about 3 µm in diameter without setae; suranal setae flagellate, about 6–7 µm long.

Dorsum with short cone-like setae, 1–2 µm high and 1–2 µm wide with a base 2.0–3.5 µm in diameter (Fig. 2c), distributed in a transverse row of 6 setae per abdominal segment, segmentally arranged on thorax, scattered on head, with setae of adjacent body segments lining up to form 3 pairs of longitudinal rows: 1 medial, 1 submedial and 1 submarginal, with submarginal setae largest especially on abdomen; macrotubular ducts, microtubular ducts and quinquelocular pores absent.

Venter with flagellate setae 3–7 µm long, 3 pairs on head near antennae, 1 seta near base of each fore leg, and abdominal setae distributed in transverse rows of 6 setae on each segment with setae of adjacent segments lining up to form 3 pairs of longitudinal rows; macrotubular ducts and microtubular ducts absent; a single trilocular pore (Fig. 2a), 3 µm in diameter, adjacent to each spiracle.

Etymology. This species is named in honour of Professor Jack Beardsley who collected all known

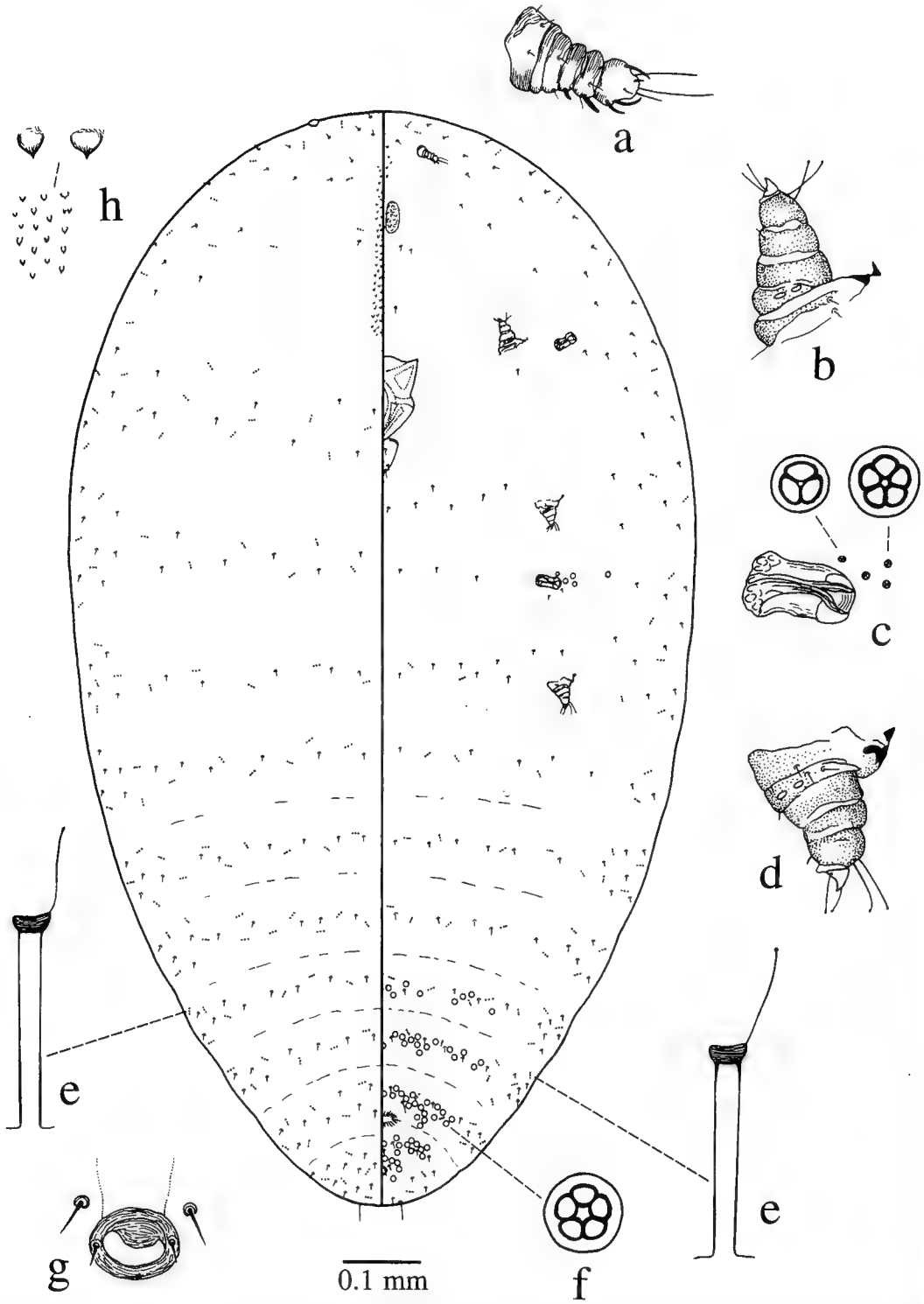

Figure 1. Adult female of *Subcorticoccus beardsleyi* sp. nov. Enlargements show: a, antenna; b, fore leg; c, metathoracic spiracle and associated pores; d, hind leg; e, macrotubular duct; f, abdominal quinquelocular pore; g, anal ring with suranal setae lateral to ring (NB. all of these structures are ventral); h, microtrichia from dorsal band on head and anterior thorax.

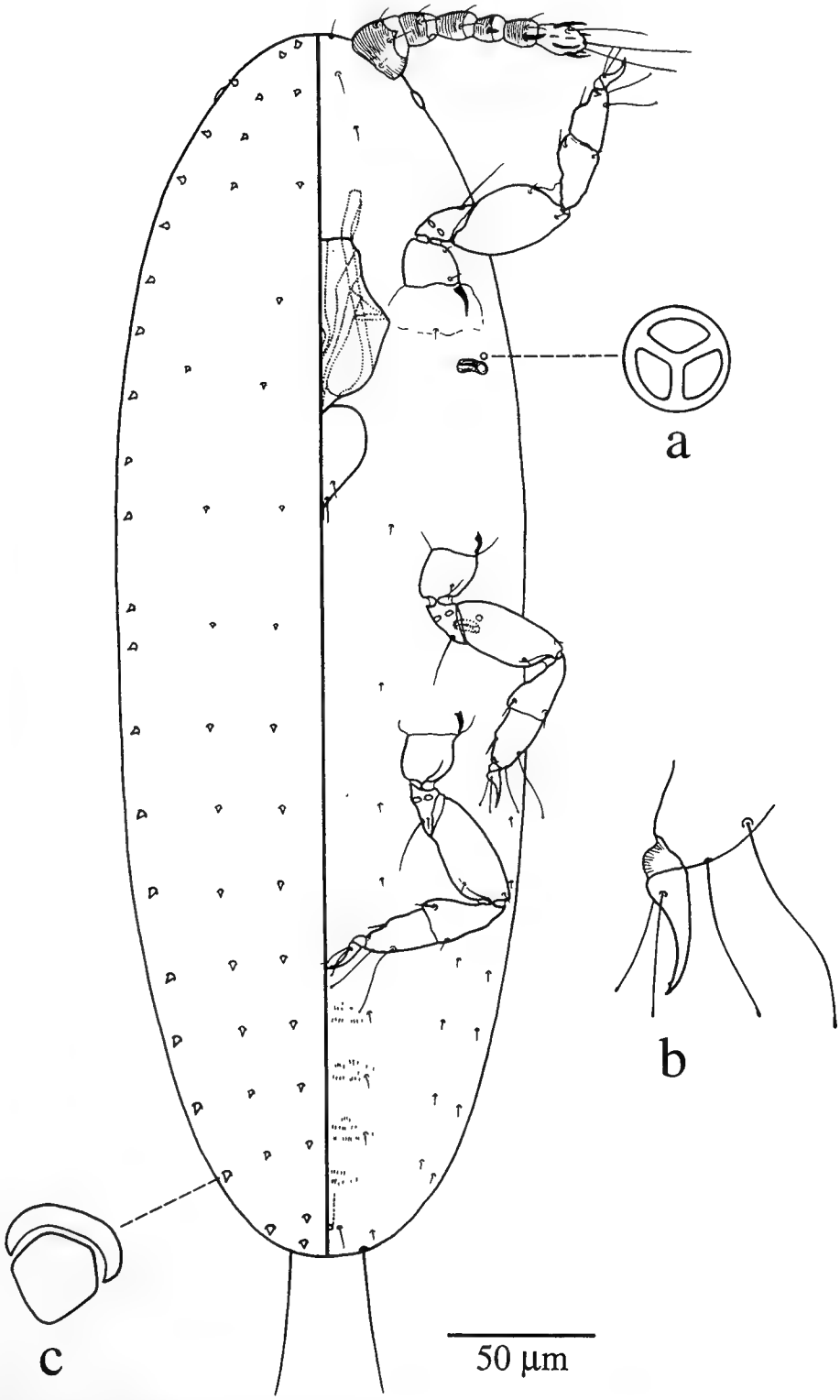

Figure 2. First-instar nymph of *Subcorticoccus beardsleyi* sp. nov. Enlargements show: a, trilocular pore; b, midleg claw and tarsal apex; c, dorsal seta.

specimens of this species and many other Australian eriococcids.

Subcorticoccus huonamnis sp. nov.

Figure 3

Type material. Holotype: adult female (3.4 mm long), Tasmania, Huon River near Judbury, 24 Oct 1978, ex *Eucalyptus regnans*, under bark, D.J. Williams (ANIC).

Paratypes: 28 adult females (9 slides), same data as holotype (2 slides in ANIC, 7 slides in BMNH).

Description of adult female (measurements based on 10 slide-mounted specimens). Body 1.2–3.9 mm long, 1.1–2.7 mm wide; segmentation indistinct except on posterior abdomen. Eyespots 25–35 μm wide. Antennae (Fig. 3a) 60–95 μm long, with 6 (rarely 5) segments. Frontal lobes each 70–130 μm long, 40–90 μm wide. Labium 60–85 mm long, 70–100 mm wide across base. Clypeolabral shield 140–230 μm long, 125–200 μm maximum width. Spiracles (Fig. 3c): mesothoracic 42–58 μm long, 20–30 μm wide; metathoracic 45–70 μm long, 23–30 μm wide. Legs (Figs 3b,d) 70–120 μm long, with segments reduced and coxa mostly membranous; tarsal digitules 20–32 μm long; claw digitules 15–25 μm long; claw with small denticle discernible near apex on some specimens. Apical setae 30–50 μm long; anal ring (Fig. 3g) 23–29 mm in diameter, with 0–1 pair of anal ring setae, 10–18 μm long; suranal setae (Fig. 3g) 10–12 μm long.

Dorsum with mediolongitudinal band of microtrichia (Fig. 3h) on head and anterior thorax 280–600 μm long, widest (40–100 μm) in posterior two-thirds; flagellate setae, 5–10 μm long, sparsely distributed across all segments, longest on posterior abdominal segments; macrotubular ducts (Fig. 3e) 10–15 μm long, 1.5–2.0 μm wide, scattered across all segments; quinquelocular pores absent.

Venter with microtrichia in short, mediolongitudinal cluster 60–100 μm long, 25–38 μm wide, between antennae; flagellate setae 5–12 μm long, sparsely distributed across all segments, one pair of longer setae (15–23 μm) near vulva; macrotubular ducts (Fig. 3e) 10–15 μm long, 1.5–2.0 μm wide, scattered across all segments; quinquelocular pores 4–5 μm in diameter sometimes present on margins of body, at least on abdomen, larger pores about 5–6 μm in diameter (Fig. 3f) in dense bands on abdominal segments V to VIII, a few scattered or clustered on IV, plus a loose cluster of 13–25 pores (Fig. 3c), each 3–5 μm in diameter, at opening of each spiracle and a few in each spiracular furrow.

Etymology. After the type locality on the Huon River, Tasmania, and *amnis*, meaning river, Latin.

Subcorticoccus murrindindi sp. nov.

Figure 4

Type material. Holotype: adult female (3.5 mm long), Victoria, c. 10.5 km NE of Toolangi, near Murrindindi River, off Murrindindi Road, 31 Oct 1978, ex *Eucalyptus regnans*, under bark, P.J. Gullan and A. Smith (ANIC).

Paratypes: 8 adult females, same data as holotype (4 slides in ANIC, 2 slides in BPBM, 2 slides in BMNH).

Description of adult female (measurements based on 7 slide-mounted specimens). Body 3.4–3.9 mm long, 2.1–2.4 mm wide; segmentation distinct, at least on abdomen. Eyespots 27–35 μm wide. Antennae (Fig. 4a) 85–125 μm long, with 7 (rarely 6) segments. Frontal lobes oval, each 65–155 μm long, 50–65 μm wide. Labium 70–85 mm long, 100–110 μm wide across base. Clypeolabral shield 150–170 μm long, 140–160 μm maximum width. Spiracles (Fig. 4c): mesothoracic 55–72 μm long, 30–35 μm wide; metathoracic 60–75 μm long, 30–35 μm wide. Legs (Figs 4b, d) of typical form but small, 112–160 μm long, tibia and tarsus of each leg fused, tibia + tarsus about equal in length to femur of each leg; tarsal digitules 20–35 μm long; claw digitules 13–20 μm long; claw sometimes with a barely discernible denticle. Apical setae 35–40 μm long; anal ring (Fig. 4g) 27–33 μm in diameter, with 1 pair of anal ring setae 7–13 μm long; suranal setae (Fig. 4g) 12–20 μm long.

Dorsum with mediolongitudinal band of microtrichia (Fig. 4h) on head and anterior thorax, 600–800 μm long, widest (100–130 μm) for posterior half to two-thirds; flagellate setae, 5–16 μm long, sparsely distributed across all segments, longest on posterior abdominal segments; macrotubular ducts (Fig. 4e) 12–15 μm long, 1.0–1.5 mm wide, scattered across all segments; quinquelocular pores 4–5 μm in diameter on margins of body (Fig. 4c).

Venter with microtrichia in indistinct, mediolongitudinal cluster about 50 μm long, 25–30 μm wide, between antennae; flagellate setae 7–22 μm long, sparsely distributed across all segments, a pair of longer setae (30–33 μm) near vulva; macrotubular ducts (Fig. 4e) 12–15 μm long, 1.0–1.5 μm wide, scattered across all segments; quinquelocular pores 4–5 μm in diameter (Fig. 4c) densely scattered on margins of body, larger pores about 5–6 μm in diameter (Fig. 4f) in dense

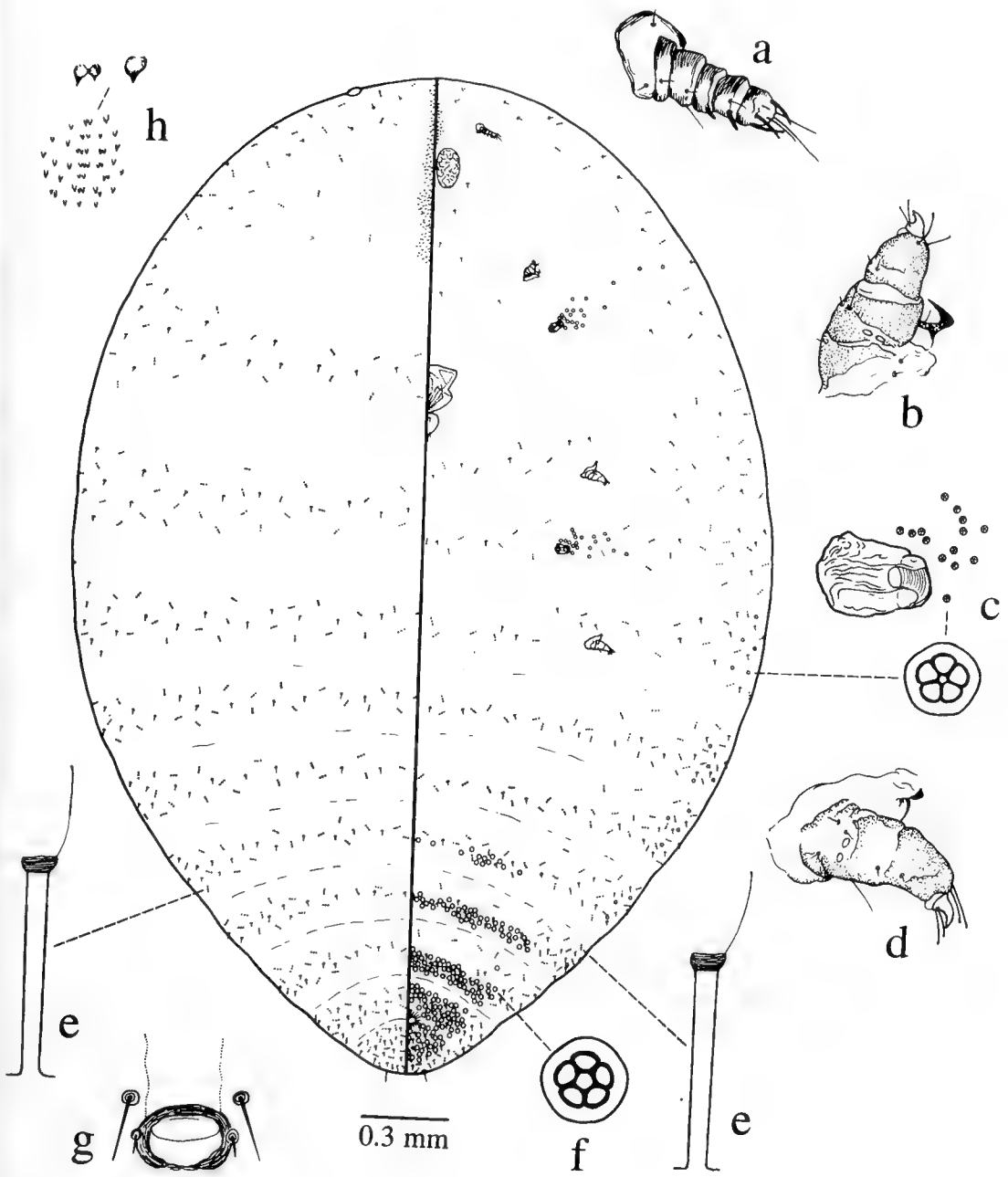

Figure 3. Adult female of *Subcorticoccus huonamnis* sp. nov. Enlargements as for caption of Fig. 1 except that, in c, the enlarged quinquelocular pore represents both pores near the spiracle and on the body margin.

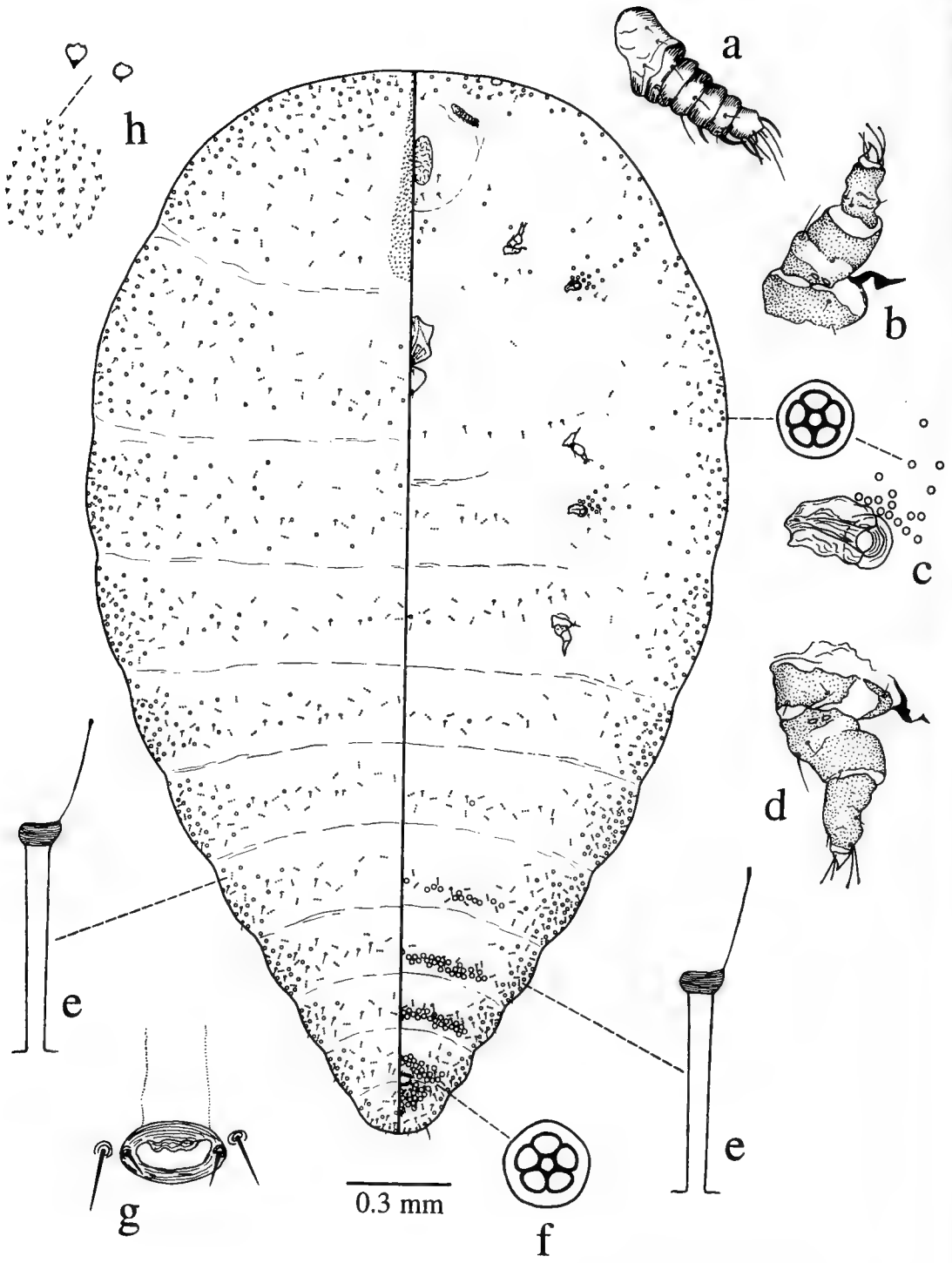

Figure 4. Adult female of *Subcorticoccus murrindindi* sp. nov. Enlargements as for caption of Fig. 1 except that, in c, the enlarged quinquelocular pore represents both pores near the spiracle and on the body margin.

bands on abdominal segments IV to VIII, a loose cluster of 15–25 pores, each 4–5 μm in diameter, at opening of each spiracle and in an irregular row in each spiracular furrow.

Etymology. For the type locality near Toolangi, Victoria, a noun in apposition.

Comments. These eriococcids were collected from under pieces of decorticating bark on their host trees. A single adult female from *Eucalyptus acmenioides* in Brisbane (A.R. Brimblecombe No. SC2207, 18.iv.1948, ANIC via H.M. Brookes) is similar to the specimens from Murrindindi Road but is only one third the body size and differs in the shape of the claws, which are distinctly hooked with a small denticle near the apex, and the shape of the frontal lobes. This female probably represents a fourth species, but its description must await the collection of further specimens.

Discussion

In addition to *Subcorticoccus* and *Phacelococcus* several other Australian eriococcid genera also have species with stationary females that live in or under eucalypt bark. The coccids are either tightly fitted into crevices or in blister galls as in *Floracoccus* Beardsley, *Ourococcus* Fuller and *Sphaerococcopsis* Cockerell (Fuller, 1899; Beardsley, 1974a, b), are under bark on twigs as in a few species of *Lachnodius* Maskell (J.W. Beardsley, pers. comm.), in resinous secretion as in *Olliffia* Fuller (P.J. Gullan, unpubl. data), or in bark crevices under felted tests as in a few species of *Eriococcus* (Froggatt, 1921). Outside Australia, some eriococcid genera, including *Capulinia* Signoret, *Cryptococcus* Douglas, *Ovaticoccus* Kloet and *Xerococcus* Ferris, have one or more species that either live under bark or in bark crevices (D.R. Miller, pers. comm.). Some of these taxa, particularly species of *Ovaticoccus* (Miller and McKenzie, 1967), display some similarity to *Subcorticoccus,* for example in possessing a reduced anal ring and small legs. The morphological reductions that accompany many bark-dwelling eriococcids make it difficult to estimate their phylogenetic relationships using cuticular features; it is hoped that their relationships may be more accurately estimated by future cladistic analysis of molecular data.

Acknowledgments

Gordon Nishida and Jon Martin kindly arranged the loan of specimens from the Bishop Museum and the Natural History Museum, respectively. The financial support of the Australian Biological Resources Study (ABRS) is gratefully acknowledged. Thanks to Peter Cranston and Dug Miller for helpful comments on the manuscript and to Robert Hoare for advice on the Latin used to form the new names. The Zoology Department of the University of Western Australia generously provided laboratory space while this paper was written, and Alan Muir at the Division of Botany and Zoology kindly made the stencil that was used to draw the tiny circles on the figures.

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Memoirs of Museum Victoria 57(2): 251–259 (1999)

A NEW SPECIES OF *OGYRIS* ANGAS (LEPIDOPTERA: LYCAENIDAE) FROM SOUTHERN ARID AUSTRALIA

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Abstract

Field, R.P., 1999. A new species of *Ogyris* Angas (Lepidoptera: Lycaenidae) from southern arid Australia. *Memoirs of Museum Victoria* 57: 251–259.

Ogyris subterrestris sp. nov. is described with the nominal subspecies *O. s. subterrestris* ssp. nov. from northwestern Victoria and the subspecies *Ogyris subterrestris petrina* ssp. nov. from near Kalgoorlie, Western Australia. Adults, male and female genitalia, and first instar larvae are figured and characters to distinguish adults and larvae of *Ogyris subterrestris* from *O. idmo* Hewitson are discussed.

Introduction

The genus *Ogyris* Angas, is an Australasian genus in the tribe Ogyrini (Eliot, 1973; Edwards, 1996). There are 15 described species in the genus, 12 occurring in Australia and three in Papua New Guinea. Of the Australian species, the larvae of ten are known to feed on mistletoes (Loranthaceae), and one feeds on the root parasitic plants in the genera *Choretrum* and *Leptomeria* (Santalaceae). The remaining species is *Ogyris idmo* (Hewitson), the largest and one of the rarest species in the genus. The life history of this species is unknown but the larvae are presumed to be predatory on ants (Field, 1997). Many species of *Ogyris* have an obligatory associated with ants whereas the others have a facultative relationship. For species in which the life history is known, these associations are presumed to be mutualistic. By day the larvae shelter with the ants in crevices, under bark or underground, emerging at night with ants in attendance, to feed. The larvae will usually pupate in these same or sheltered sites nearby.

Populations of *O. idmo* show differing wing colours and patterns, and morphologically (wing shape, antennal segments) it is a very variable species. It has been collected from western Victoria, southern South Australia, and southwestern Western Australia, from Cape Arid National Park to near Geraldton. Few specimens have been recorded outside Western Australia since 1950 but recently the species has been locally common near Perth, and at Cape Arid National Park (Field, 1990, 1992) and it has been rediscovered in South Australia (Hunt et al., 1998). Specimens from Mildura (Victoria), Broken Hill (New South Wales) and near Kalgoorlie (Western Australia), initially incorporated within the *O. idmo* complex, are here described as a new species of *Ogyris* with two new subspecies.

Material examined is stored in Museum Victoria, Melbourne (NMV), South Australian Museum, Adelaide (SAM), Australian National Insect Collection, CSIRO, Canberra (ANIC), Australian Museum (AM), Natural History Museum London (BMNH) and the private collections of the author (RPFC), R. Hay (RHC), M. Moore (MMC), and B.H. Vardy (BHVC).

Key to females of *Ogyris idmo* (Hewitson) group

1. Upperside of forewing with 2 black bars at proximal end of postmedian cream patch and with subapical region to distal end of postmedian cream patch dark brown.....*O. subterrestris* sp. nov. ... 2
— Upperside of forewing with black patch at proximal end of postmedian cream patch and with subapical region to distal end of postmedian cream patch black.....*O. idmo* ... 3

2. Upperside of forewing with postmedian cream patch regular, oval, often faint and small; upperside of hindwing with central blue patch extending anteriorly to M_1 and reaching base.....
.....*O. subterrestris subterrestris* ssp. nov. (figs 1, 2)
Upperside of forewing with postmedian cream patch irregular, distinctly divided by M_3 forming a small faint cream patch distally between M_3 and CuA_1; upperside of hindwing with central blue patch not extending anteriorly to M_1 and not reaching base.....
.....*O. subterrestris petrina* ssp. nov. (figs 5, 6)
3. Upperside of wings brown with broad basal area bright blue or bluish-purple and extending to postmedian cream patch on the forewing.....4
Upperside of wings brown with broad basal area purple but not extending to postmedian cream patch on the forewing.....*O. idmo idmo* (figs 9, 10)
4. Upperside of wings with broad basal area bluish-purple.....
.....*O. idmo halmaturia* (figs 13, 14)
Upperside of wings with basal area bright blue.....
.....*O. idmo* (Mt Ragged form) (figs 17, 18)

Key to males of *Ogyris idmo* (Hewitson) group

1. Forewing with termen at right angles to inner margin; upperside of wings with fine black line at termen..... *O. subterrestris* sp. nov. ... 2
Forewing with termen obtuse to inner margin; upperside of wings with narrow black band to termen..... *O. idmo* ... 3
2. Upperside of wings predominantly bluish-purple with strong bronze sheen to brown marginal areas; underside of hindwing with well defined markings, the grey patches contrasting the black-edged brown patches.....
.....*O. subterrestris subterrestris* ssp. nov. (figs 3, 4)
Upperside of wings predominantly brownish-purple without strong bronze sheen to brown marginal areas; underside of hindwing with poorly defined brown markings and without contrasting grey patches.....
.....*O. subterrestris petrina* ssp. nov. (figs 7, 8)
3. Forewing termen convex..... *O. idmo halmaturia* (figs 15, 16)
Forewing termen straight.....4
4. Upperside of forewings brownish-purple..... *O. idmo idmo* (figs 11, 12)
Upperside of forewings dark purple. *O. idmo* (Mt Ragged form) (figs 19, 20)

***Ogyris subterrestris* sp. nov.**

Types. See types of nominal subspecies.

Diagnosis. Females with upperside of forewing with 2 black bars at proximal end of postmedian cream patch and with subapical region distal to cream patch dark brown, males with termen at right angles to inner margin and upperside of forewing with fine black line at termen and with faint to strong bronze sheen to brown areas; first instar larvae with a pair of prominent mesothoracic dorsal spines and a pair of long, posteriorly curved dorsal spines on each of abdominal segments 6 and 7.

Remarks. The syntypic series of *O. idmo* and the holotype of *O. orontas* (Hewitson) (male), a junior subjective synonym of *O. idmo*, are held in the Natural History Museum, London. Colour images of these specimens have been examined. Although a female specimen of *O. idmo* in the Natural History Museum has the word "type" on a label, Hewitson (1862) described the species from two (female) specimens. The syntype (male) of *O. halmaturia* (Tepper) is in the South Australian Museum and has been examined. Tepper (1890) described the species from three specimens, two small specimens being the males and a larger specimen, which he believed to be the female. However, the latter was a male and the smaller specimens were male *O. otanes* (C. Felder and R. Felder). Waterhouse (1903a) synonymised part of *halmaturia* (presumably referring to the large male) with *O. idmo* and part with *O. otanes*. Waterhouse (1903b) later synonymised *halmaturia* with *otanes* and made no mention of *halmaturia* under *idmo*. Tepper's female (the large male) is the first specimen described and thus *halmaturia* can be synonymised with *idmo* but not also with *otanes*. This specimen is thus

designated the lectotype of *O. halmaturia* and is so labelled. *O. waterhouseri* (Bethune-Baker) was described, but not figured, from Victoria (Bethune-Baker, 1905) and subsequently figured, synonymised and treated as a subspecies of *O. idmo* by Waterhouse and Lyell (1914). *O. waterhouseri* has generally been treated as a junior subjective synonym of *O. i. halmaturia* (Common and Waterhouse, 1981) but both McCubbin (1971) and D'Abrera (1971) retained *waterhouseri* as a distinct subspecies. This paper recognises *waterhouseri* as a junior subjective synonym of *halmaturia*. The type series of *O. waterhouseri* could not be located but presumably consisted of one female and at least two males (based on size ranges given in the description). The original description, which highlighted the "strongly arched" termen, Waterhouse and Lyell's figuring of the species along with locality data, clearly separates *O. waterhouseri* from *O. subterrestris* sp. nov.

Etymology. Sub- and *terrestris* (Latin), underground, referring to the larval and pupal stages thought to be completely subterranean.

Ogyris subterrestris subterrestris ssp. nov.

Figures 1–4

Types. Holotype: female, Pink Lakes, Murray-Sunset NP, 15 km N Lima, Victoria, 35°03.45'S, 142°43.13'E, 20.x.1996, R.P. Field (NMV T-17264).

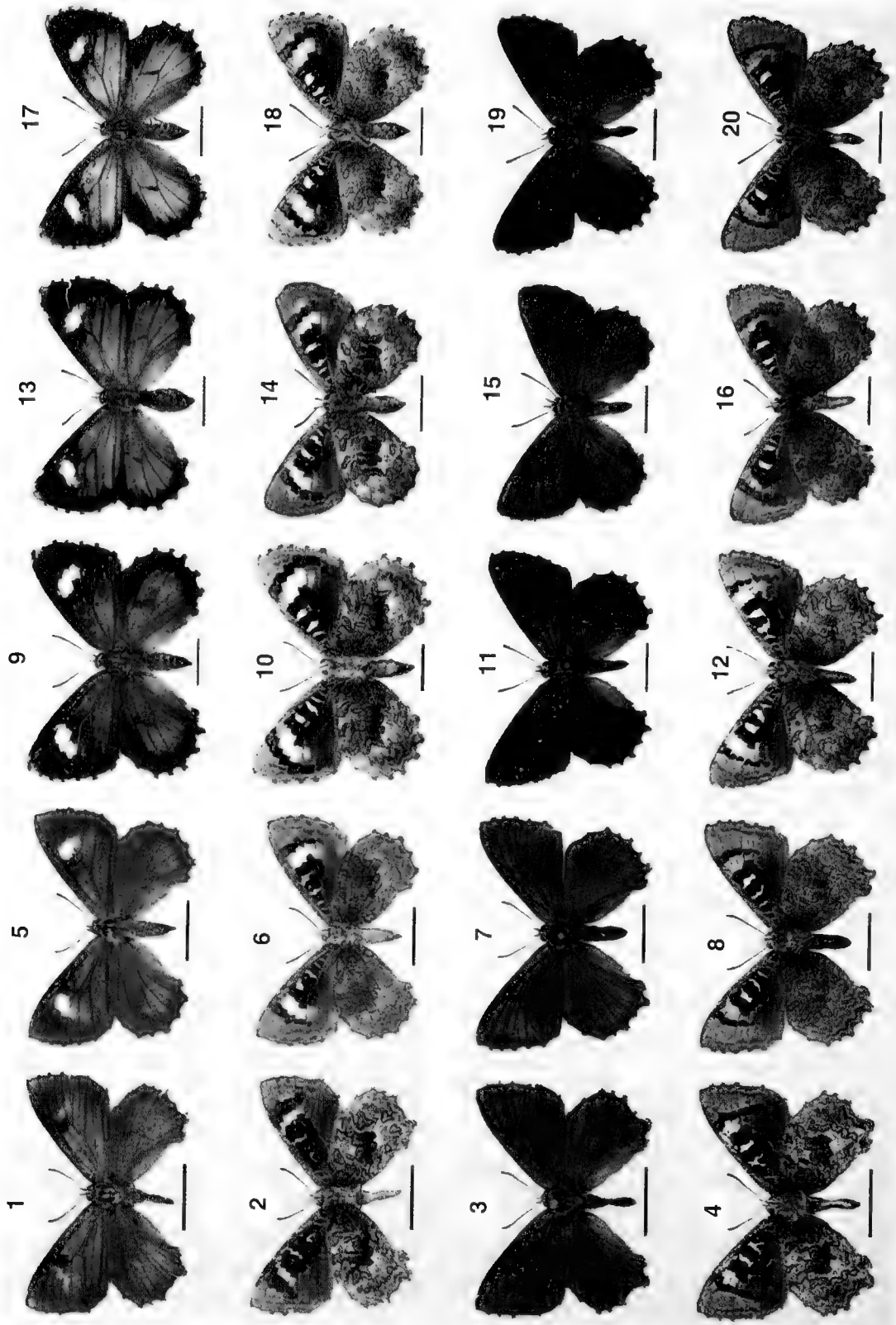
Paratypes (all Victoria): 1 male, same data as holotype (NMV T-17265); 1 female, 150 m NW of Ring Road at 1 km NNE of junction with Grub Tk, Pink Lakes, Murray-Sunset NP, F. Noelker, 18.ii.1996 (NMV T-17267); 11 males, 2 females, same data as holotype; 1 male, Pink Lakes, Murray-Sunset NP, 15 km N of Lima, 12.iv.1996, R.P. Field (RPFC); 1 female, Mildura 16.x.1972, B. H. Vardy, 1 male, Mildura, 26.x.1972, B. H. Vardy (ANIC); 1 male, 2 females, Mildura, 26.x.1972, B. H. Vardy (BHVC).

Other material examined. Victoria: 1 female, Lake Waltah, xi. 1918, F.R. Spry, G.A. Waterhouse Collection (AM KL 20211).

New South Wales: 1 male, Broken Hill, xii.1912 (NMV LEP 6272).

South Australia: 1 female, Koonibba Mission, nr Ceduna; 1 male, Loxton, 1986, Hudson (SAM); 1 male, 7.5 km NW Ramco, 13.x.1993, 34°07'38"S, 139°53'22"E, P.J. Peile; 3 females, 7.5 km NW Ramco, 34°07'38"S, 139°53'22"E, 12.iii.1994, R.P. Field; 1 male, 1 female, 7.5 km NW Ramco, 13.iii.1994, R.P. Field; 1 female 7.5 km NW Ramco, 34°07'38"S, 139°53'22"E, 14.iii.1994, R.P. Field; 4 males, 3 females, 7.5 km NW Ramco, 34°07'38"S, 139°53'22"E, 30.x.1994, R.P. Field (all RPFC); 1 female, 10.v.1992, Qualco; 1 female, 19.i.1993, Qualco; 4 males, 1 female, 25.ii.1993, Qualco; 1 female 26.ii.1993, Qualco; 2 males, 19.iii.1993, Qualco; 1 female, 20.iii.1993, Qualco; 1 female, 20.iv.1993, Qualco; 1 female, 28.ix.1993, Qualco; 1 male, 2.x.1993, Qualco (all MMC).

Description. Female. (figs 1, 2). Antennal length (of holotype) 7.1 mm, flagellum 37 segments, brown and bronze with segmental bands narrowly banded black with lateral white scales; club short, apically broad, rounded, tipped orange. Head, palpus, thorax and abdomen dorsally brown with white scales, ventrally white with brown scales; legs speckled brown and white; ventral surface of head, thorax, base of abdomen, all of coxae with long white hair scales; dorsal surface of thorax with long bronze hair scales. All tibiae of equal length, first and third femora equal length of tibiae, mid femur much longer than tibiae. Forewing length (of holotype) 21.0 mm, apex weakly acute, rounded, termen slightly convex; above central area from base to subterminal area and from subcostal area to inner margin royal blue, remaining areas and veins browny bronze except for narrow black bar proximal to discocellulars, wide black bar distal to discocellulars between M_1 and M_3 proximally edging a postmedian cream patch between M_2 and M_3 which extends faintly towards M_1 and CuA_1. Hindwing termen crenated convex; above central area from base to subterminal area and from M_1 to CuA_2 royal blue, remaining areas, veins and bands at discocellulars browny bronze, long tan hair scales throughout cell and from base to termen at CuA_2 and to inner margin. Cilia of both wings white, browny bronze at veins. Beneath forewing base colour grey, dark brown cell, extending to basal fifth of area between M_1 and M_3, basal third of M_3 to CuA_1, basal quarter of CuA_1 to CuA_2, and circular brown patch between junction of cubitus and CuA_1 and 1A + 2A narrowly edged near 1A+2A with white and iridescent blue scales; cell with 2 iridescent light blue bands 1 median band from proximal end of Rs to base of CuA_1, the other subbasal parallel to radius with bend towards cubitus distally; 2 fine white inner subbasal lines between radius and cubitus; prominent postmedian cream band extending from M_1 to nearly CuA_1 slightly stepped towards termen between M_3 and CuA_1; broad subterminal brown band from costa to CuA_1, twice as wide at costa than at CuA_1 edged dark brown; prominent white scales in subcostal, subapical and apical areas. Hindwing base colour grey with irregular brown or white patches edged dark brown; 2 subbasal dark brown lines, between costa and Sc + R_1 subparallel to basal Sc + R_1 then bending back to costa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subparallel to mid Sc + R_1 and between Sc + R_1 and cubitus displaced towards termen between Sc + R_1 and radial sector; submedian lines dark brown from Sc + R_1 to cubitus (2), radial sector to mid cell, cubitus (nearly) to anal vein; median lines from Sc + R1 to Rs (2), Rs to M_1, M_1 to M_3 (2) 1 either side of discocellulars, M_3 to CuA_1, CuA_1 to CuA_2, 1A+2A to anal vein; postmedian dark brown lines between Rs and M_1, M_1 and M_3 (2), dark brown edged v markings between M_3 and CuA_1 and CuA_1 and CuA_2; brown areas basal fifth of M_2 to CuA_1 extending proximally into cell, basal quarter of CuA_1 to CuA_2 extending proximally into cell and spot distal to junction of CuA_1 and CuA_2 between CuA_2 and 1A + 2A edged dark brown; costa and termen edged dark brown.

Genitalia (Fig. 21): Apophyses anteriores long, slender; papillae anales broadly acute, setose; ostium bursae broad, weakly sclerotised; ductus bursae not sclerotised, membranous, broad, moderately long, expanding to rounded, membranous corpus bursae.

Male. (figs 3, 4). Antennal length 6.6–8.3 mm (mean 7.6 mm, n=20), flagellum 34–41 segments (mean 38, n=20). Colour of head, palpi, antennae, thorax, abdomen and legs similar to female. Forewing length 19.5–23.5 (mean 21.7 mm, n=20), apex acute, termen straight or slightly concave, above similar to female but without postmedian cream patch and darker purple blue; remaining areas, veins and narrow band at discocellulars bronze. Hindwing above similar to female but darker purple blue central area and bronze submarginal areas; beneath similar to female (holotype) but postmedian cream band of forewing more grey and median iridescent light blue band in cell often broader, subbasal iridescent band often more extensive forming a cross and an additional narrow basal iridescent band in cell; subterminal brown band narrower than in female but extending past CuA_1 often to CuA_2.

Genitalia (fig. 22): Vinculum+tegumen ring oval, saccus small, blunt; uncus lobes narrow, bases close dorsally, setae numerous, brachia long, U-shaped, curved laterally inwards, broad basally tapering to a blunt point; valva broadly triangular, numerous long setae on posterior margin concentrated near dorsal and ventral regions; juxta prominent, v-shaped; aedeagus long, straight, basal fifth swollen, zone broad; postzonal sheath length longer than half the pre-zonal sheath, broad, displaced ventrally near base with cornuti well developed near zone, apically round.

Variation. Female, size of the cream spot on the forewing varies from almost absent to a small patch; flagellum 36 44 segments (mean 39, n=20), length 6.8 8.3 mm (mean 7.7 mm, n=20), wing length 20-25.5 mm (mean 22.7 mm, n=20).

Distribution. In Victoria the subspecies occurs in the Murray Sunset National Park, near Linga and was recorded from Mildura, in October 1972 (B. Vardy collection). A single specimen was recorded from Broken Hill, New South Wales, in December 1912 (Museum Victoria). In South Australia it occurs locally in a small remnant roadside strip of mallee vegetation, near Ramco, (Moore, 1999) and has also been recorded near Loxton and near Ceduna.

***Ogyris subterrestris petrina* ssp. nov.**

Figures 5–8

Types. Holotype: female, Western Australia: female, Lake Douglas, 12 km SW of Kalgoorlie, 12.xi.1989, R.P. Field (NMV T-17268).

Paratypes: 1 male, Lake Douglas, 12 km SW of Kalgoorlie, 4.x.1991, R.P. Field (NMV T-17269). 1 male, 1 female, Lake Douglas, 12 km SW of Kalgoorlie, 1.ii.1982, A.J. Graham 12 males, 3 females, Lake Douglas, 12 km SW of Kalgoorlie, 16.x.1986, A.J. Graham; 4 females, Lake Douglas, 12 km SW of Kalgoorlie, 17.x.1986, A.J. Graham; 1 male, Lake Douglas, Kalgoorlie, 22.xi.1991, L. R. Ring, (all ANIC); 1 female, Lake Douglas, 12 km SW of Kalgoorlie, 5.x.1987, R.P. Field; 3 males, 5 females, Lake Douglas, 12 km SW of Kalgoorlie, 6.x.1987, R.P. Field; 2 males, Lake Douglas, 12 km SW of Kalgoorlie, 7.x.1987, R.P. Field; 1 male, 1 female, Lake Douglas, 12 km SW of Kalgoorlie, 9.xii.1989, R.P. Field; 2 males, Lake Douglas, 12 km SW of Kalgoorlie, 10.xii.1989, R.P. Field; 3 males, Lake Douglas, 12 km SW of Kalgoorlie, 11.xii.1989, R.P. Field; 2 males, 4 females, Lake Douglas, 12 km

Figures 1–4, *Ogyris subterrestris subterrestris* ssp. nov. 1, 2, holotype female upperside and underside; 3, 4, paratype male upperside and underside.

Figures 5–8, *Ogyris subterrestris petrina* ssp. nov. 5, 6, holotype female upperside and underside; 7, 8, paratype male upperside and underside.

Figures 9–12, *Ogyris idmo idmo*. 9, 10, female upperside and underside; 11, 12, male upperside and underside.

Figures 13–16, *Ogyris idmo. Halmaturia*. 13, 14, female upperside and underside; 15, 16, male upperside and underside.

Figures 17–20, *Ogyris idmo* (Mt Ragged form). 17, 18, female upperside and underside; 19, 20, male upperside and underside. Scale lines 1 mm.

SW of Kalgoorlie, 12.xii.1989, R.P. Field; 1 female, Lake Douglas, 12 km SW of Kalgoorlie, 3.x.1991, R.P. Field; 2 males, 2 females, Lake Douglas, 12 km SW of Kalgoorlie, 4.x.1991, R.P. Field, (all RPFC); 1 female, 13.xii.1986, R. H. (WAM 96/177); 2 males, 1 female, 14.xii.1986, R.H. (WAM 96/175, 96/176, 96/178); 1 female, Lake Douglas, 30.xi.1985, R.H.; 1 male, Kalgoorlie, 14.xii.1986, R.H.; 1 male, Lake Douglas, 28.ii.1988, R.H.; 1 female, Lake Douglas, 3.x.1991, R. H.; 4 males, Lake Douglas, 4.x.1991, R.H.; 1 female, Lake Douglas, 5.x.1991, R. H.; 2 males, 2 females, Lake Douglas, 6.x.1991, R.H.; 1 male, Lake Douglas, 8.x.1991, R. H.; 1 male, Kalgoorlie, 9.x.1991, R.H. (all RHC).

Other material examined. Western Australia: 1 female, S. W. Australia, Kalgoorlie district, W. Subiaco, 23.x.1911, W.J. Brooks (BMNH).

Description. Female. (figs 5, 6). Antennal length (of holotype) 7.9 mm, flagellum 41 segments, brown and bronze with segmental bands narrowly banded black with lateral white scales; club short, apically broad, rounded, tipped orange. Head, palpus, thorax and abdomen dorsally brown with white scales, ventrally white with brown scales; legs speckled brown and white; ventral surface of head, thorax, base of abdomen, all of coxae with long white hair scales; dorsal surface of thorax with long bronze hair scales. All tibiae of equal length, first and third femora equal length of tibiae, mid femur much longer than tibiae. Forewing length (of holotype) 21.0 mm, apex weakly acute, rounded, termen slightly convex; above central area from base to median area in cell and subterminal area at CuA_1 and from subcostal area to inner margin purple blue; discocellulars and veins browny bronze, remaining areas, brown with scattered browny bronze scales except for narrow brown black bar proximal to discocellulars and a narrow brown black bar distal to discocellulars between M_1 and M_3 proximally edging a large postmedian cream patch between M1 and M3 which extends faintly towards CuA1. Hindwing termen crenated convex; above central area from base to subterminal area and from M_2 to CuA_2 purple blue, discocellulars and veins browny bronze, remaining areas, brown with scattered browny bronze scales, long tan hair scales throughout cell and from base to termen at CuA_2 and to inner margin. Cilia of both wings white, brown at veins. Beneath forewing base colour grey with dark brown cell, extending to basal sixth of area between M_1 and M_3, basal quarter of M_3 to CuA_1, basal third of CuA_1 to CuA_2, cell with median iridescent light blue patch and 2 iridescent light blue bands 1 sub-medial and 1 subbasal, 2 fine white inner subbasal lines between radius and cubitus; prominent postmedian cream band extending from M_1 to nearly CuA_1 slightly stepped towards termen between M_3 and CuA_1; broad subterminal brown band from costa to midway between CuA_1 and CuA_2, twice as wide at costa as at CuA_1 edged dark brown; prominent white scales in subcostal, subapical and subterminal areas. Hindwing base colour grey and flecked with white scales with irregular brown lines; 2 subbasal dark brown lines, between the costa and Sc + R_1 and back to costa subparallel to basal Sc + R_1 and between radial sector and cubitus, subbasal brown ring between anal vein and inner margin; submedian dark brown lines between Sc + R_1 and radial sector (2), radial sector and cubitus (2), cubitus to 1A+2A; median dark brown lines from Sc + R_1 to Rs (2), M_1 to M_3 (2) 1 either side of discocellulars, 1A+2A to anal vein median dark brown rings (3), in cell half the width of the cell at the base of CuA_1, between M_3 and CuA_1 and between CuA_1 and CuA_2, median brown spot distal to junction of CuA_1 and CuA_2 between CuA_2 and 1A + 2A; postmedian dark brown lines Rs to M_1(2), M_1 to M_2 (2), M_3 to CuA_1, CuA_1 to CuA_2, CuA_2 to 1A+2A; termen edged dark brown.

Male. (figs 7, 8). Antennal length 7.3–8.5 mm (mean 8.1, mm, n=19), flagellum 37–43 segments (mean 40, n=20) colour of head, palpi, antennae, thorax, abdomen and legs similar to female. Forewing length 21.5–24.5 mm (mean 23.4 mm, n=19), apex acute, termen straight or slightly concave, above similar to female but without postmedian cream patch and central area browny purple. Hindwing above similar to female but central area browny purple and browny bronze submarginal areas; beneath similar to female but postmedian cream band of forewing more grey and iridescent light blue bands in cell often broader; subterminal brown band narrower than in female but extending past CuA_1 often to CuA_2.

Etymology. Petra and *-ina* (Latin), small rock, upon which females will sometimes oviposit; also the name of my wife.

Variation. Female, flagellum 39–43 segments (mean 41, n=20), length 6.8–8.6 mm (mean 8.3 mm, n=18), wing length 22–25 mm (mean 22.7, n=18).

Distribution. Western Australia, *Ogyris subterrestris petrina* is known only from a few square kilometres to the north east of Lake Douglas, near Kalgoorlie

Biology

The life history of *O. subterrestris* is largely unknown. It is associated with the sugar ant *Camponotus terebrans* (Lowne), the same species

that is associated with all populations of *O. idmo* and *O. otanes* (C. and R. Felder) (McArthur et al., 1997). *O. subterrestris* has been recorded every month from September to May with peak flight activity in mid-spring and late summer and is probably bivoltine at all locations. Near Waikerie and at Pink Lakes males fly low in open grassland and on nearby ridges whereas females generally fly close to the trees where the ant nests occur. At Kalgoorlie, the butterflies are sparse but have definite flight paths and often exhibit hill-topping and individuals, particularly males, fly to the tops of small rises and settle on the ground. Females are also often found on these rises.

The eggs are laid close to the ground at or in the entrance to the ants' nest usually on the bark of trees or occasionally on small stones. At most locations the trees are mallee eucalypts, *Eucalyptus concinna* Maiden & Blakely near Kalgoorlie (Field, 1992), *E. oleosa* F. Muell., *E. foecunda* Schauer, and *E. pileata* Blakely but also exotic garden eucalypts and *Myoporum platycarpum* R. Br. near Waikerie, South Australia (Moore, 1999) and *E. largiflorens* F. Muell. at Mildura, Victoria. At the type location only one egg has been found (on a mallee eucalypt) although ant nests are abundant, occurring at the base of many plants, not only eucalypts.

At Lake Douglas in 1991, ant nests at the base of 50 randomly chosen *E. concinna* trees were examined. Egg clusters of *O. subterrestris* were found on 18 trees with 26 clusters present, four of which were unhatched. Egg shells seem to remain attached to the bark for several years. The cluster size averaged 7.8 eggs (range 2–20) with 11% of the eggs parasitised. In 1989 an encyrtid wasp (*Ooencyrtus* sp.) was reared from one cluster of eggs (Field, 1990). Captive females readily oviposit on stones and bark taken from the entrance of ant nests, producing clusters of 40 or more eggs if left undisturbed. Nearly 90% of the eggs laid in the field were in the northern to western quarter of the tree. However, the entrances to the ant nest seemed to be well distributed around the base of the tree and averaged 7.2 holes/tree (range 1–18). Female butterflies that were caged over ant nests readily oviposited, but only between 1145 h and 1300 h, when the sun was shining on the northwestern sector of the base of the tree. During this period the ants, which are predominantly nocturnal, exhibit little activity above ground. If disturbed during the day the ants will leave the nest and attack intruders. It is likely that the butterflies oviposit during periods when the sun is shining on the base of the tree and the ants have retreated further underground. This enables the females to back into the nest entrances to oviposit undisturbed. Near Waikerie, hundreds of old eggs occur on some trees with few eggs showing evidence of parasitism.

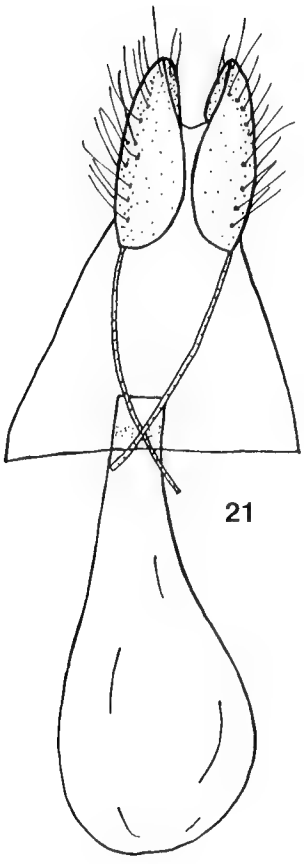
Newly hatched larvae are carried in the mandibles of ants or walk into the ant nest where larval growth and pupation occurs. The first instar larvae of *O. subterrestris* (Fig. 23) has morphological differences from *O. idmo idmo* (Fig. 24). *O. subterrestris* has two pairs of dorsal posteriorly curving abdominal spines, a pair on segment 6 and on segment 7. A smaller pair of dorsal spines also occurs on the mesothorax. These spines do not occur on second instar larvae. There are no spines on first instar *O. idmo*, but numerous long hairs occur on the lateral margin of the abdomen and thorax and there are numerous clubbed secondary setae on the thorax and abdomen. As with *O. idmo*, the larval food is unknown. The larvae and pupae are thought to be totally subterranean and probably have an obligatory association with *C. terebrans*. Adult pinned specimens of *O. idmo* and *O. subterrestris* often develop greasy wings, a feature commonly occurring in lycaenids that are known to have predatory larvae (Sands, 1980).

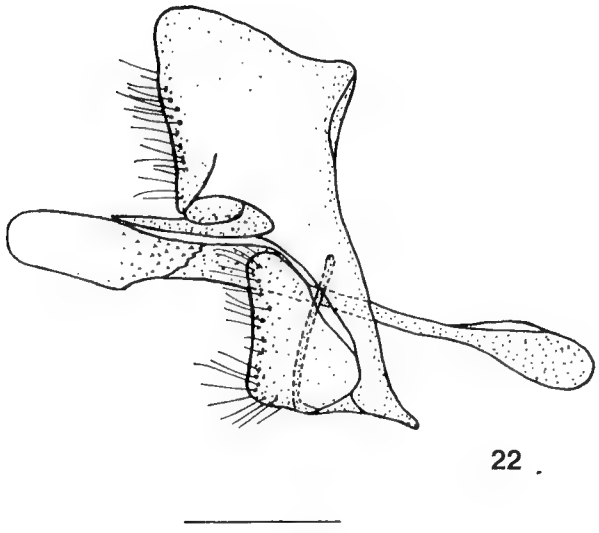
Discussion

A female specimen of *O. subterrestris subterrestris* in the AM and labelled Lake Waltah, a nonexistent location, and bearing the name F. R. Spry, is most likely incorrectly labelled but may refer to Lake Hattah, a location between the two known Victorian locations of the species. Spry's diaries (held in the NMV) do not indicate that he travelled in northwestern Victoria during November 1918, hence he probably labelled this specimen with misinterpreted data from the collector.

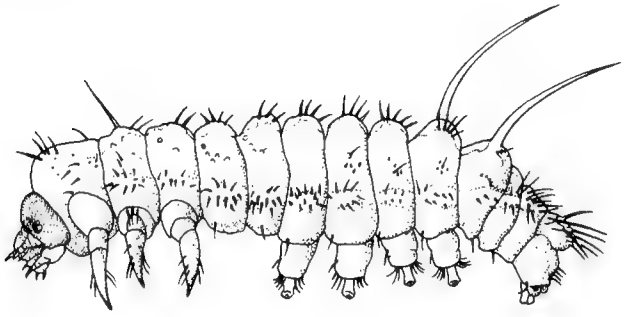
Braby et al. (1997) proposed a common name for this species of Mallee Bronze Azure. However, there are records of *O. subterrestris subterrestris* from mallee and non-mallee areas (Broken Hill, NSW, Mildura, Vic and near Ceduna, SA) and *O. idmo*, both the western and eastern populations, also occurs in mallee vegetation as well as heathland. A more appropriate common name would therefore be Arid Bronze Azure, reflecting the more arid climatic regions in which the species is found in comparison to *O. idmo* (Field, 1997).

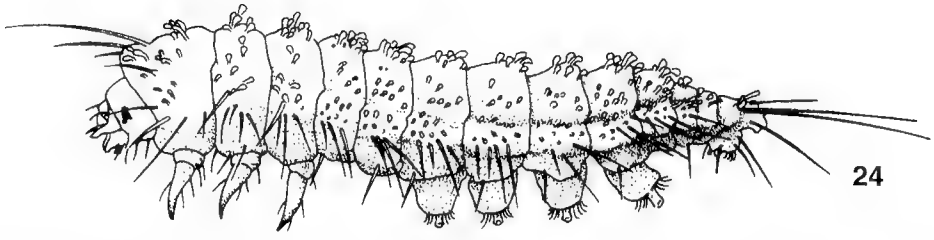
Most colonies of *O. subterrestris* occur in disturbed areas. The colony at Lake Douglas occurs within a public recreation area that can be subjected to significant human interference with numerous vehicle tracks crossing the main breeding areas. In some years, since its first discovery





Figures 21, 22. Genitalia of *Ogyris subterrestris subterrestris* sp. nov.: 21, female; 22, male.





Figures 23, 24. First instar larvae of *Ogyris*: 23, *O. subterrestris* sp. nov.; 24, *O. idmo idmo*. Scale line 1 mm.

in the early 1980s, the butterflies have been common, but few specimens have been seen since 1991 (Field, 1997). Near Waikerie, citrus orchards and vineyards surround the breeding area. These crops are regularly sprayed with pesticide during flight periods of the butterfly. Adults fly commonly in the adjoining farmland as well as in the breeding area and a nearby ridge. The only known extant location of *O. subterrestris* in Victoria is the type location in the Murray Sunset National Park. This relatively undisturbed location is the most secure of all populations of the species (Field, 1997).

The *Ogyris idmo* complex covers colour and pattern variants, morphological and/or behaviouraly distinct populations of *O. idmo* and *O. subterrestris*. Nowhere are specimens common. Both *O. idmo idmo* and *O. idmo halmaturia* are univoltine with peak flight activity in mid to late November. The Mt Ragged form of *idmo* has a longer flight activity period, flying in early/mid October with specimen activity still occurring in late December. Specimens from near Geraldton more closely resemble the Mt Ragged form of *O. idmo* than typical *idmo* and fly in September. Flight activity during the day also differs amongst the complex. Female *idmo* tend to be active only in the late morning, whereas males are mainly active in the afternoon. However, at Mt Ragged, males and females are active throughout the day. Hunt et al. (1998) reported male *halmaturia* having a peak flight activity in the late morning. Both sexes of *O. subterrestris* are active throughout the day although during the heat of mid afternoon, specimens may shelter in trees. The complex may yet reveal more species than *O. idmo* and *O. subterrestris*. Larval characters have proven useful in separating species in the complex. Further studies on the behaviour and immature stages of the various *idmo* populations may clarify the colour and morphological differences that occur in the adult populations.

Acknowledgements

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Memoirs of Museum Victoria 57(2): 261 (1999)

REPLACEMENT NAMES FOR FIVE SPECIES OF AUSTRALIAN *LASIOGLOSSUM (CHILALICTUS)* (HYMENOPTERA: HALICTIDAE).

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Abstract

Walker, K.L., 1999. Replacement names for five species of Australian *Lasioglossum (Chilalictus)* (Hymenoptera: Halictidae). *Memoirs of Museum Victoria* 57: 261.

Replacement names for one primary homonym and four secondary homonyms within *Lasioglossum (Chilalictus)* are proposed. The primary homonym change is: *L. clariventre* (Friese, 1924) = *L. impunctatum* nom. nov. The secondary homonym changes are: *L. bidens* Walker, 1995 = *L. bidentatulum* nom. nov., *L. megacephalum* Walker, 1995 = *L. platychilum* nom. nov., *L. occidens* Walker, 1995 = *L. occiduum* nom. nov., *L. soror* Walker, 1995 = *L. sororculum* nom. nov., and *L. striatum* Walker, 1995 = *L. seriatum* nom. nov.

Walker (1995) erected 73 new species of *Lasioglossum* Curtis within the endemic Australian subgenus *Chilalictus* Michener. Unfortunately, four of these names created secondary homonyms and one existing primary homonym was not identified and corrected. I propose new names for these homonyms.

Halictus clariventris Friese, 1924 is a primary homonym of *Halictus clariventris* Dalla Torres, 1896 and is replaced with *Lasioglossum impunctatum* nom. nov.

Lasioglossum bidens Walker, 1995 is a secondary homonym of *Halictus bidens* Cameron, 1904 and is replaced with *Lasioglossum bidentatulum* nom. nov.

Lasioglossum megacephalum Walker, 1995 is a secondary homonym of *Halictus megacephalus* Schenck, 1869 and is replaced with *Lasioglossum platychilum* nom. nov.

Lasioglossum occidens Walker, 1995 is a secondary homonym of *Halictus occidens* Smith, 1873 and is replaced with *Lasioglossum occiduum* nom. nov.

Lasioglossum soror Walker, 1995 is a secondary homonym of *Halictus soror* Saunders, 1901and is replaced with *Lasioglossum sororculum* nom. nov.

Lasioglossum striatum Walker, 1995 is a secondary homonym of *Halictus striatus* Schenk, 1868 and is replaced with *Lasioglossum seriatum* nom. nov.

I sincerely thank Pastor Andreas Werner Ebmer for alerting me to these homonyms.

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Memoirs of Museum Victoria 57(2): 263–266 (1999)

DESIGNATION OF TYPE SPECIES FOR THE GENERA OF AUSTRALIAN PAROPSINE BEETLES (COLEOPTERA: CHRYSOMELIDAE)

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Abstract

Kelly, P.G. and Reid, C.A.M., 1999. Designation of type species for the genera of Australian paropsine beetles (Coleoptera: Chrysomelidae). *Memoirs of Museum Victoria* 57: 263–266.

Type species are listed for all Australian genera in the subtribe Paropsina, including necessary first designations for *Chrysophtharta* Weise, *Faex* Weise, *Notoclea* Marsham, *Pyrgoides* gen. nov., *Sterromela* Weise, *Trachymela* Weise and *Trochalodes* Weise. The synonymy of *Notoclea* with *Paropsis* Olivier, and *Pyrgoides* with *Acacicola* Lea are confirmed. A new species synonym is recorded: *Paropsis hamadryas* Stål = *Acacicola tristis* Lea.

Introduction

The paropsine chrysomelids are among the most diverse and taxonomically intricate group of beetles associated with natural vegetation in Australian. A few paropsines have in recent years become serious pests in eucalypt plantations in Australia, New Zealand and South Africa. Many of the 450 described species have been allocated uncritically to genus and the genera themselves have not always been delineated clearly. This paper is a start towards resolving these taxonomic problems.

The genus *Paropsis* was erected by Olivier (1807) for 14 Australian chrysomelid species. Marsham (1808) erected the genus *Notoclea* with 20 species which were incorporated into *Paropsis* by Olivier (1825). Subsequently, Boisduval (1835), Erichson (1842), Germar (1848), Boheman (1858), Stål (1860), Clark (1864, 1866), Baly (1864), Chapuis (1877) and Blackburn (1890–1901) added large numbers of species to the genus, so that by 1916, 406 species were listed from Australia (Weise, 1916). Since 1916, a number of species have been described by Weise (1817, 1923), Lea (1924), Gressitt (1963) and Selman (1983), and the current total is about 450 species.

This large number of rather similar species, many with quite inadequate descriptions, has made identification by later workers very difficult. Several attempts have been made to split *Paropsis* into smaller groups. Motschulsky (1960) split three genera from *Paropsis*, namely *Dicranosterna, Niliosoma*, and *Paropsisterna*. Blackburn, in a series of papers (1897a–1901) arranged *Paropsis* into five "groups" and a number of "subgroups" while still retaining the genus *Paropsis* for all species. Weise (1901–1915) split *Paropsis* into nine genera: *Sterromela* Weise, *Trochalodes* Weise, and *Dicranosterna* Motschulsky in the tribe Dicranosternini Weise and *Paropsis* Olivier, *Paropsisterna* Motschulsky, *Chrysophtharta* Weise, *Trachymela* Weise, *Faex* Weise, *Procris* Weise, *Philhydronopa* Weise and *Pyrgo* Weise in the tribe Paropsinini Weise. Most of these genera are poorly diagnosed with no accompanying illustrations. Some are defined only by the species that Weise placed in them and most lack designated type species.

Daccordi (1994) presented a checklist of world chrysomeline genera and made several new synonymic designations in the paropsine genera, thus at present 15 Australian genera are considered valid.

For this paper type specimens were examined for most designated type species and where none was available specimens named by Blackburn or Lea were used. The validity of these genera is not discussed here.

Australian generic names in the Paropsina (*sensu* Daccordi, 1994), with designated type species

The name *Coccinelloides* Latreille is not listed below. Selman (1963) following Weise (1916) claimed that this is an available generic-rank name based on a species, "australasiae", without authorship. He then decided that *Chrysomela australasiae* Fabricius was the intended species and declared this to be the type species. We believe that the phrase "coccinelloides australasiae" of Latreille (1807:58) was never meant to be generic but was merely descriptive and this is clearly how Latreille uses the term 'coccinelloides' in a later work (1825: 10).

Acacicola Lea, 1902: 392

Type species. Acacicola tristis Lea, 1903 by monotypy.

Chondromela Weise, 1915: 435

Type species. Chondromela mjoebergi Weise, 1915 by monotypy.

Chrysophtharta Weise, 1901: 165

Type species. Weise (1901) did not nominate a type species but listed six species. The first of these, *Paropsis nobilitata* Erichson, 1842, is here designated type species.

Dicranosterna Motschulsky, 1860: 193

Type species. Paropsis picea Olivier, 1807 by original designation.

Faex Weise 1901: 165

Type species. Weise (1901) did not designate a type species but listed three species names. The first, *Paropsis notatipennis* Chapuis, 1877 is here designated type species.

Niliosoma Motschulsky, 1860: 194

Type species. Paropsis testacea Olivier, 1807 by original designation. This species is unrecognisable and the type is apparently lost. *Niliosoma* is therefore a *nomen dubium* and unusable, but it any case it has always been ignored by Australian workers.

Notoclea Marsham, 1808: 283

Type species. Marsham described 20 species in this genus but failed to designate a type. *Notoclea obsoleta* Marsham, 1808 is hereby designated type species. *Notoclea obsoleta* is a junior synonym and homonym of *Paropsis obsoleta* Olivier, 1808 therefore synonymy of the two genera is confirmed (Daccordi, 1994).

Novacastria Selman, 1983a: 179

Type species. Novacastria nothofagi Selman, 1983 by original designation and monotypy.

Paropsides Motschulsky, 1860: 192

Type species. Paropsis duodecimpustulata Gebler, 1825 by original designation.

Paropsis Olivier, 1807: 596

Type species. Paropsis obsoleta Olivier, 1807 by subsequent designation (Selman, 1963).

Paropsisterna Motschulsky, 1860: 192

Type species. Notoclea sexpustulata Marsham, 1808 by original designation.

Philhydronopa Weise, 1901: 166

Type species. Paropsis aeneipennis Chapuis, 1877 by original designation.

Procrisina Aslam, 1968: 129

Procris Weise, 1901: 165, nec Fabricius, 1807 (junior homonym).

Clorindina Jolivet, 1957: 170, nec Khodalerich, 1930 (junior homonym).

Clorindiella Jolivet, 1971: 382 (unecessary nom. nov.).

Type species. Paropsis pictipennis Boheman, 1858 by original designation (Weise, 1901).

Pyrgoides gen. nov.

Pyrgo Weise 1901: 166, nec Defrance, 1824 (junior homonym).

Pyrgoides Aslam, 1968: 129 (nomen nudum, no type species)

Type species. The name *Pyrogoides* was proposed by Aslam (1968) as a replacement name for the preoccupied *Pyrgo* Weise. Published after 1930 Aslam's name is unavailable as no type species was designated (ICZN Article 13(b)). We make it available here. Weise (1901) did not designate a type species of *Pyrgo* but listed a number of species to be included in his genus. *Paropsis hamadryas* Stål, 1860, one of these, is hereby designated type species. This species is a senior synonym of *Acacicola tristis* Lea (**syn. nov.**; types examined), thereby confirming synonymy of *Pyrgoides* with *Acacicola* Lea (Daccordi, 1994).

Rhaebosterna Weise, 1917: 124

Type species. Rhaebosterna sciola Weise, 1917 by monotypy.

Sterromela Weise, 1915: 436

Type species. Weise (1915) placed four species of *Paropsis* in *Sterromela* without designating a type species. The first named of these, *Paropsis subcostata* Chapuis, 1877 is here designated type species.

Trochalodes Weise, 1901: 167

Type species. No type species was designated by Weise (1901) but three species were named, two erroneously. The first and only correctly named species, *Paropsis circe* Stål, 1860 is here designated the type species.

Trachymela Weise, 1908: 8

Type species. No type species was deisgnated by Weise but he listed three species names and, by inference, all species in Blackburn's Group III of *Paropsis*. One of the listed names, *Paropsis sloanei* Blackburn 1897, is here designated type species.

Xanthogramma Weise, 1923: 63

Type species. Xanthogramma pellucida Weise, 1923 by monotypy.

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We are grateful to Dr T. New (LaTrobe University, Melbourne), Dr K. Walker (Museum Victoria, Melbourne) and Dr E. Matthews (South Australian Museum, Adelaide) for access to collections and helpful discussion. This work was completed with assistance to PGK from the Science and Industry Endowment Board.

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STORTHYNGURELLA, NEW GENUS OF MUNNOPSIDAE (CRUSTACEA: ISOPODA), WITH DESCRIPTIONS OF THREE NEW SPECIES FROM DEEP-SEA BASINS OF THE SOUTHERN HEMISPHERE

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Abstract

Malyutina, M.V., 1999. *Storthyngurella*, new genus of Munnopsidae (Crustacea: Isopoda), with descriptions of three new species from deep-sea basins of the Southern Hemisphere. *Memoirs of Museum Victoria* 57: 267 285.

A new genus *Storthyngurella* and three new species are described from deep-sea basins and trenches of the Southern Hemisphere. *Storthyngurella* is characterised by: long dorsal and lateral spines on the body; a terminal spine on the pleotelson; a long spine on the basal article of both antennae; narrow posterior pereopods 5–7; elongated distal lobes of male pleopod 1 extending far beyond the distal margins of pleopods 2; a long stylet of male pleopod 2, which is more than two-thirds as long as the protopod; and elongated uropods with tubular protopod and rami. The new genus is most similar to *Storthyngura* and *Microprotus*.

Introduction

A specialised deep-sea family Munnopsidae Sars, 1869 is characterised by natatory posterior legs with paddle-like carpi and propodi bearing plumose setae, fused compact natasome and streamline body outline. A small group of munnopsid genera is distingushed by spinose body, fused but non-compact natasome, and relatively narrow pereopods 5–7, which in some cases are lacking natatory setae. This group comprises *Acanthocope* Beddard, 1885, *Storthyngura* Vanhöffen, 1914, and *Microprotus* Richardson, 1910. The most numerous (more than 40 species) and widespread genus *Storthyngura* shows variable external morphology. Its species are distinguished by different number and length of body spines, shape of pleotelson, and morphology of appendages. Among the representatives of the genus large active swimmers, which swim backwards, are characterised by relatively compact muscular body, paddle-like pereopods 5–7, and short body processes directed forward; also a few elegant, brittle species have thin, long spines and narrow, often walking posterior legs. George and Menzies (1968a) tried to divide the genus into five groups and 14 subgroups. Although they wrote that their analysis was based on 158 characters, description of these subdivisions was based mainly on pleotelson morphology. Nevertheless, the groups were distinguished by other morphological characters such as armament of the antennae, morphology of the posterior pairs of pereopods and male pleopods. The artificiality of such a classification was noted by subsequent authors (Birstein, 1969; Wilson et al., 1989). Working with *Storthyngura* specimens collected by RV *Akademik Kurchatov* (cruises 11 and 43) and RV *Dmitrii Mendeleev* (cruises 16 and 43) from deep-sea trenches and basins of the Southern Hemisphere, I was able to compare 12 species of this genus. The new genus *Storthyngurella* is erected for three new species described in this paper and five previously known species of *Storthyngura*.

I am indebted to colleagues from the Laboratory of Benthos in Shirshov's Institute of Oceanology, Moscow, for the privilege of being able to examine the *Storthyngura* collections. The terminology and measurements follow Wilson and Hessler (1980). When measuring the body proportions the body spines were omitted. The type material is deposited in the Zoological Museum of Moscow University, Moscow, Russia (ZMMU) and Museum Victoria, Melbourne, Australia (NMV).

Suborder Asellota

Munnopsidae Sars, 1869

Storthyngurella, gen. nov.

Type species. Storthyngurella hirsuta sp. nov.

Diagnosis. Body slender, with long spines: dorsal on cephalon, pereonites and pleotelson, lateral on coxae of pereopods 1–4, pereonites 4–7 and pleotelson, and terminal on pleotelson. Posterior body part (natasome) longer than anterior part, non-compact, with distinct waist (narrowed anterior part of pereonite 5), pleotelson longer than broad, with long preanal ventral process. Antenna 1 sexually dimorphic: in males 1.5–2 times as long as in females, basal article of antenna 1 with long medial spine, basal article of antenna 2 with long lateral spine. Mandible normal, with cuticular posterolateral projection articulated with cephalon in elongate notch, proximal portion of mandibular body up to condyle and palp abbreviated. Pereopods 5–7 thin, either with tubular carpus and propodus lacking natatory setae or with flattened articles provided with short plumose setae, either on dorsal margin or in both. Dactyli of pereopods 2–7 with acute dorsal claw provided with inner acute projection. Male pleopod 1 elongated without distinct waist midlength, with long distal lobes making angle to each other and extending in situ far beyond distal margins of pleopods 2. Male pleopod 2 endopod inserted in midlength of protopod medial margins, stylet length more than two-thirds of protopod length, exopod with long distal hook. Pleopod 3 endopod with 3–4, exopod with numerous plumose setae. Uropod elongate, with tubular protopod and rami subequal in length.

Additional description. Body widest at pereonite 4, long dorsal and lateral spines directed perpendicularly to body axis and (or) backward (only in *S. digitata* body spines are short and of unusual bulbous shape). Cephalon without rostrum, broader than long, with pair (2 pairs in *S. digitata*) of long dorsal spines, laterally projecting cheeks at mandibular articulation point; frons sloping with frontal arch semicircular in frontal veiw, clypeus significantly broader than labrum. Pereonites 1–4 slightly broadening and lengthening from 1 to 4, pereonites 2–4 with 3 dorsal spines (in *S. wolffi* sp.nov. and *S. benti* only with 1 spine), anterolateral margins of pereonites 1–3 rounded, of pereonite 4 with long spines, coxae of pereopod 1 with 1, of pereopods 2–4 with 2 long spines. Pereonites 5–7 and pleotelson fused, dorsal sutures visible, ventral sutures absent, each pereonite bearing pair of dorsal spines located relatively far from each other and anterolateral long spines with narrow basis. Pleotelson with several (1–6) dorsal and 3 lateral spines (2 spines and a process between them in *S. wolffi* sp. nov. and *S. digitata*) directed backward. Basal article of antenna 1 same (equal) in both sexes, elongated, with subparallel margins, flattened lateral lobe and medial spine, exeeding in length article width, article 2 length 0.3 article 1 length and subequal in length to article 5, article 3 slightly longer than article 2, article 4 shortest among first five, in males articles 2–5 broader and stronger than in females, flagellar articles in male short, numerous, in female flagellar articles less numerous, longer, subequal in length to article 4. Basal article of antenna 2 with long lateral spine, article 2 without spines, article 3 with 2–3 spines. Mandibular incisor process broad, flattened and more or less curved, condyle shorter than molar process, which narrowed distally, with row of small denticles and setae on tip, palp normal, long, thin, last article twisted. Maxilla 1 inner lobe with numerous small, thin distal setae, distomedial seta largest. Maxilla 2 lobes subequal in length, middle and outer lobes with 4 long spine-like distal setae, inner lobe bears thin simple marginal setae, distal setae more strong, some pectinated. Maxillipedal palp inserting in midlength of basis, palp article 3 with semicircular medial margin, epipod elongated, lateral margin smoth, lacking acuted rolling process. Pereopod 1 much smaller than posterior pereopods, having only simple setae, carpus slightly curved, dactylar dorsal claw finger-like, rounded distally. Pereopods 2–4 progressively lengthening; straight carpi and propodi, bearing strong, unequal bifid ventral setae and sparse simple thin dorsal setae. All bases subequal in length. Male pleopods 2 not connected to each other, fully separated by insertion of pleopods 1; pleopod 2 protopod semicircular, lateral and distal margins with plumose setae. Female pleopod 2 (operculum) oval, with plumose marginal setae, median keel low, with or without spine.

Species included. All species except the new ones were transfered from the genus *Storthyngura* (Table 1).

Geographic distribution. Species of the genus *Storthyngurella* have been found mainly in the Southern Hemisphere: from Middle American Trench, 12°N to 61°S in the Atlantic and in the southeastern Indian Ocean in the depths of 2596 to 7200 m.

Table 1. List of species of *Storthyngurella* gen. nov.

Species	Locality: (A), Atlantic, (I), Indian, (P), Pacific Oceans	Depths (m)
S. hirsuta sp. nov.	(A) South Sandwich Trench: 56°07′–56°52′S, 24°56′–24°59′W	5530–6150
S. wolffi sp. nov.	(I) South Australian Basin: 43°36.5′S, 144°04′E	4464
	(P) Solander Depression: 54°57.5′S, 163°51′E	4590
	(P) Hjort Trench: 57°17′S, 157°13′E	5460 5760
S. menziesi sp. nov.	(A) Argentine Basin: 38°40′S, 48°08′W; 48°52′S, 26°36′W	5225
		4560–4570
S. benti (Wolff, 1956)	(P) Kermadec Trench: 32°10′–36°07′S, 175°54′ -178°32′W	5340–7000
S. spinosa (Beddard, 1885)	(I) South Indian Basin: 54°S, 109°E	3567
S. triplispinosa (George and Menzies, 1962)	(P) Panama Basin: 16°12′S, 74°41′W	2856–2596
	(P) Middle American Trench: 12°11′N, 89°34′W	5680–5690
	(A) 45°34′S, 06°02′W	4588
S. digitata (Menzies, 1962)	(A) Argentine Basin: 44°53.3′S, 51°26.5′W	5843
	36°12′–38°40′S, 48°08′–49°10′ W	4630–5255
S. zenkevitchi (Birstein, 1969)	(A) Romanche Gap: 01°01′S, 18°21.55′E	7200

Etymology. Representatives of the new genus are similar to but smaller and more elegant than species of *Storthyngura*. The diminutive suffix *-ella* is added to *Storthyngura*.

Remarks. *Storthyngurella* gen. nov. has clear affinities with the genera *Storthyngura* and *Microprotus*. From *Storthyngura*, the new genus differs in smaller body size, longer body spines and their arrangement, terminal spine of pleotelson, long spines on the first articles of both antennae, narrow pereopods 5–7, long distal lobes of male pleopods 1 which make an angle to each other and extent far beyond the distal margins of pleopods 2, and longer stylet of pleopods 2, inserting at the midlength of the protopod.

Until now the presence of tubular pereopods 5–7 in Munnopsidae was described only for *Microprotus*. At least two species of *Storthyngurella*, *S. menziesi* and *S. triplispinosa*, have such legs, while other *Storthyngurella* species have carpi and propodi of pereopods 5–7 significantly narrower than in all munnopsids except *Microprotus*. Plumose setae in *Storthyngurella* species show different stages of reduction: either short plumose setae located on both margins of narrow carpi and propodi, or carpi and propodi bearing small plumose setae on dorsal margins and unequal bifid setae on ventral margins, or the plumose setae totally reduced. Wilson et al. (1989) discussed the hypothesis that there is secondary reversion of natatory legs into walking ones within this specialised swimming family. An intermediate stage of such a transformation is seen in *Storthyngurella*. Besides the narrow legs, long spines of the body, pair long spines on the coxae of pereopods 1–4, long spine on the article 1 and article 3 of antenna 2 and long tubular uropods also make the new genus similar to *Microprotus*.

In spite of external similarity between *Storthyngurella* gen. nov. and *Acanthocope* (both have a long terminal spine on pleotelson, body spines, long uropods and narrow pereopods 5–7) a more detailed analysis did not confirm their close affinity. The monotypic subfamily Acanthocopinae is well isolated from other spiny munnopsid genera, first by the different structure of male genital apparatus (Malyutina, in press). Therefore, Wägele's (1989) unification of *Acanthocope*, *Storthyngura* and *Microprotus* into Acanthocopinae is dubious.

Storthyngurella hirsuta sp. nov.

Figures 1–3

Material examined. Holotype. South-Sandwich Trench, RV *Akademik Kurchatov*, cruise 11, stn 898 (56°47′S, 24°56′W), 6052–6150 m, ZMMU Mc 1316 (male, 11.1 mm long).

Paratypes. Type locality, ZMMU Mc 1317a (8 males, 7.4–12.3 mm long; 6 females, 9.3–11.7 mm long; 14 fragmented specimens), NMV J45733 (1 male, 1 female). Stn 896 (56°52′S, 24°9′W), 5530–5651 m, ZMMU Mc 1317b (5 males, 12 females, 6.5–13.4 mm long; fragments of 6 specimens).

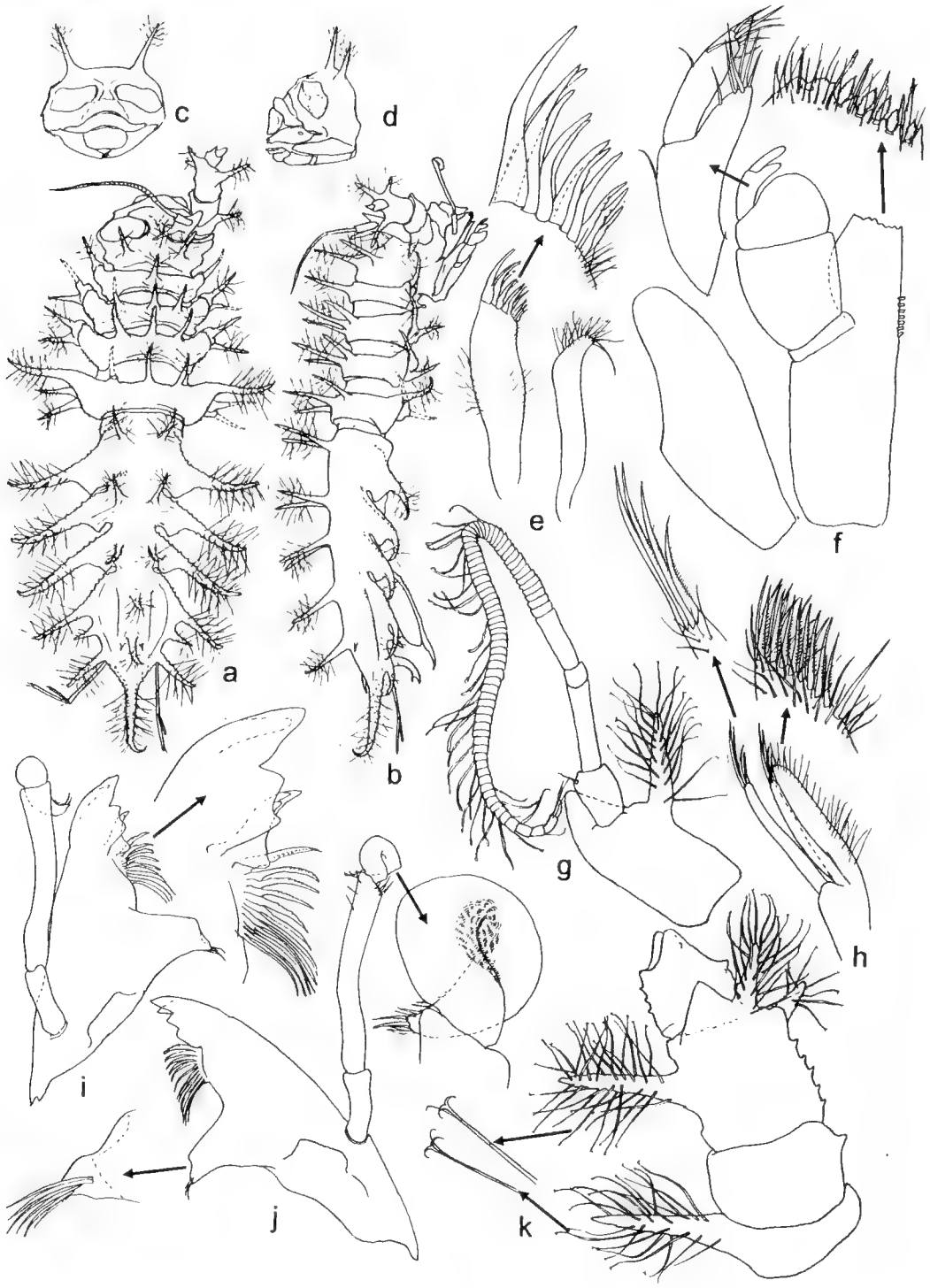

Figure 1. *Storthyngurella hirsuta* sp. nov., male, holotype: a, b, dorsal and lateral views of body; c, d, frontal and lateral views of cephalon; e, maxilla 1; f, maxilliped; g, antenna 1; h, maxilla 2; i, left mandible; j, right mandible; k, peduncle of antenna 2.

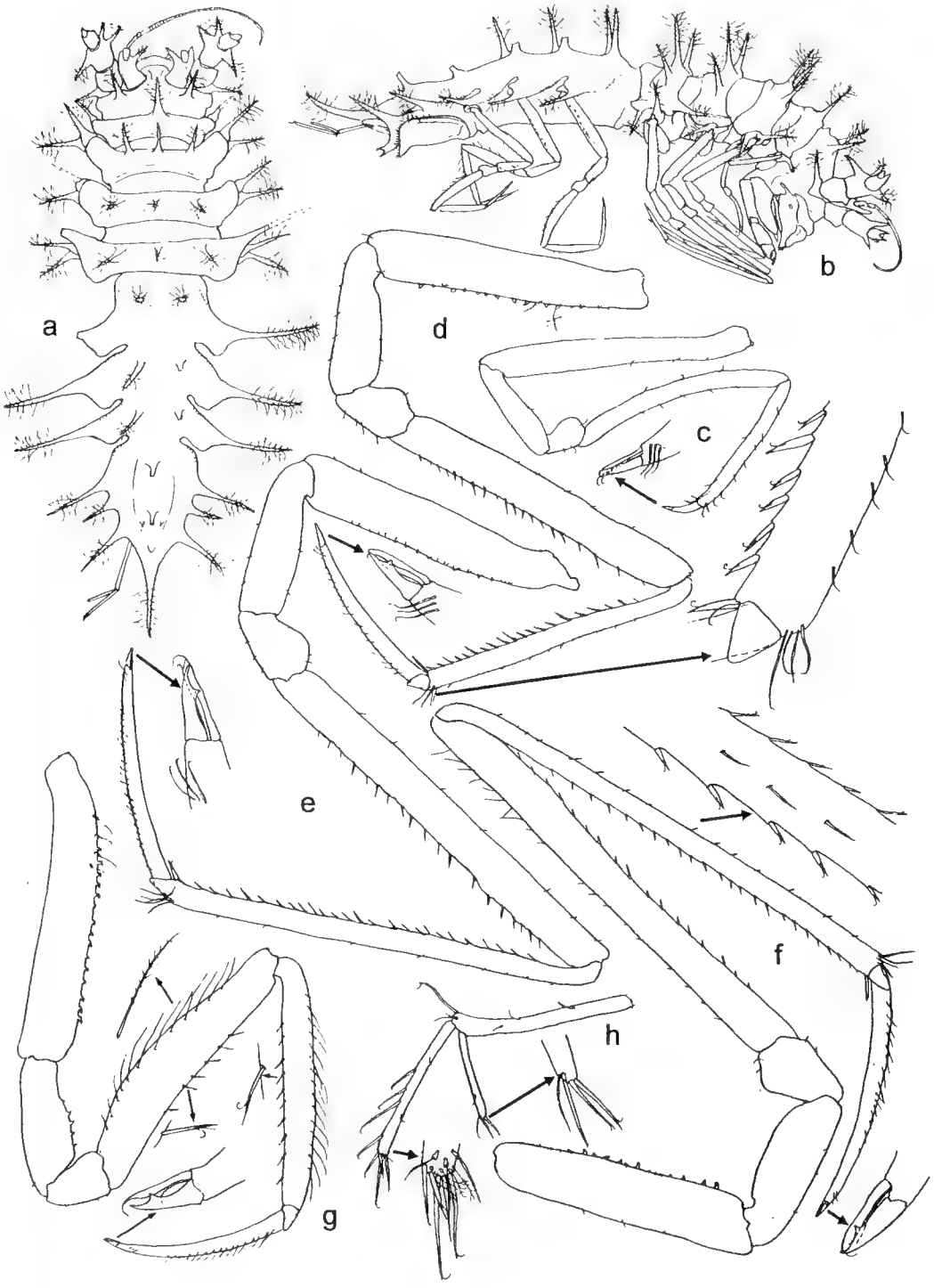

Figure 2. *Storthyngurella hirsuta* sp. nov.: a, b, female, paratype, dorsal and lateral views of body; male, holotype: c–g, pereopods 1–5; h, uropod.

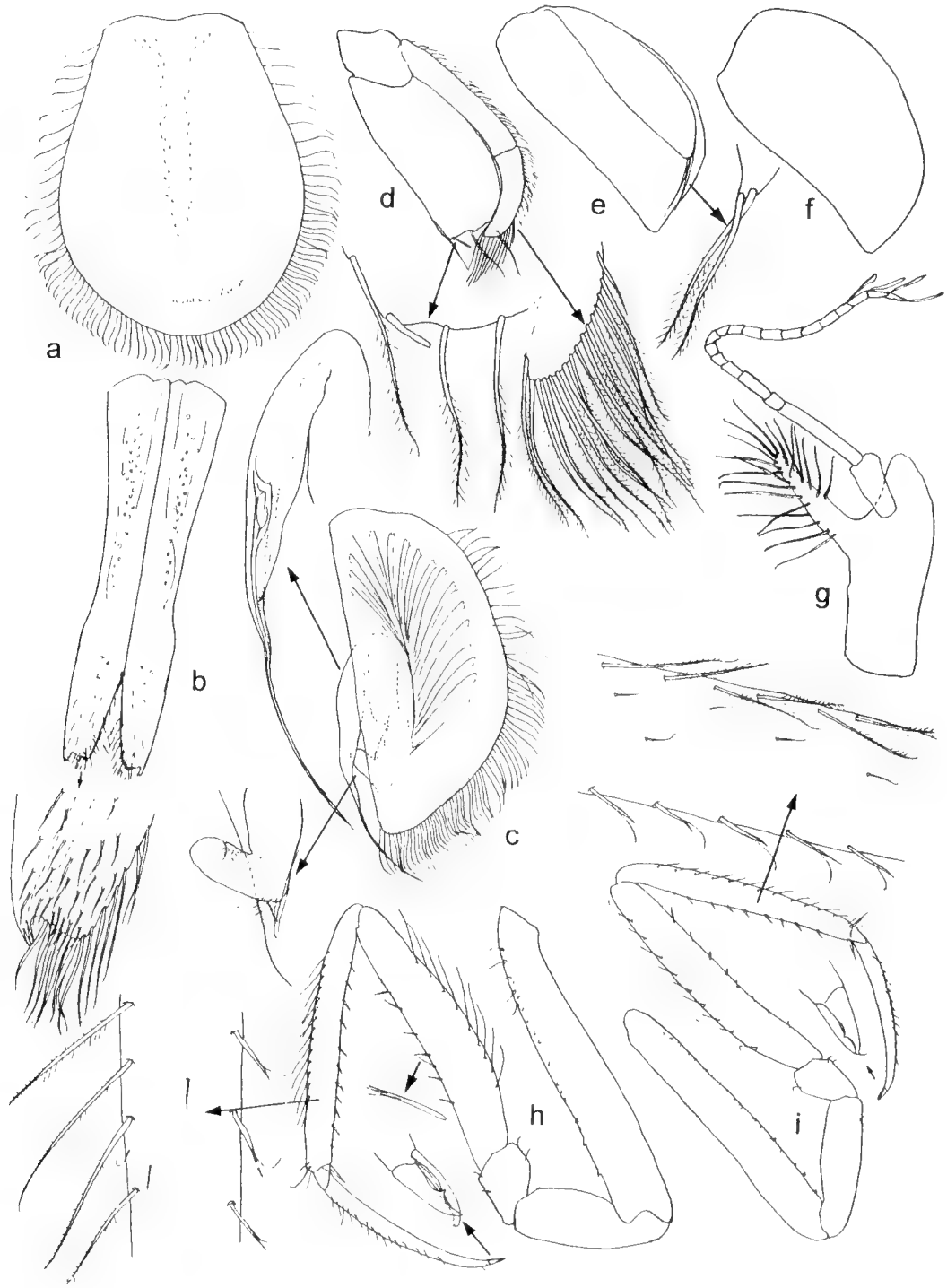

Figure 3. *Storthyngurella hirsuta* sp. nov.: a, operculum of female, paratype; b–f, pleopods 1–5 of male, holotype; g, antenna 1 of female, paratype; h, i, pereopods 6, 7 of male, holotype.

Description of the holotype. Body (Figs 1a, b) slender, length 3.4 times width, height 0.14 times length. Cephalon length 0.56 times width, distance between antennae 1 is 0.1 cephalon width. Frons (Figs 1c, d) sloping, concave medially, frontal arch low, clypeus 1.9 times as long as labrum, clypeus width 0.8 labrum width. Pereonite 1 with 1, pereonites 2–4 with 3 dorsal medial long spines. Anterolateral spines of pereonite 4 perpendicular to body axis, half as long as pereonite width. Coxae spines of pereopods 1–4 much shorter than lateral spines of pereonite 4. Posterior body part 1.3 times as long as anterior part. Pereonite 5 longer than pereonites 6 and 7, the last 2 subequal in length, with long waist in anterior part; pereonites gradually narrowing from 5 to 7, their long anterolateral spines direct backward and slightly upward distally.

Pleotelson subtriangular, its length 1.2 times width, terminal spine length 0.7 pleotelson length, spine turning up distally, its lateral sides with 3 spines: anterior and posterior long, slightly curved upward, medial spine shorter, curved downward. Dorsal surface with 2 long medial spines and 2 short spinules on the sides and slightly behind the posterior medial spine. Preanal ventral process of pleotelson long, narrow, slightly curved backward, with concave notch. Lateral margins of pereonites, pleotelson, and body spines covered with small acute tubercles. All spines on body, coxae and antennae look like bristle-scourer, with dense, long, hair-like bifid setae (Fig. 1k).

Antenna 1 (Fig. 1g) length 0.3 times body length, article 1 is 2.3 times as long as wide, article medial length 1.3 article width, article 1 extends almost to article 2 distal end. Article 2 length 0.45 article 1 length, articles 3–5 length 1.2, 0.3, and 0.9 article 2 length respectively, flagellum of numerous short articles, some with aesthetases.

Antenna 2 (Fig. 1k) broken, only basal part present. Article 1 lateral spine equal in length to article 1 width, article 2 twice as long as article 1, article 3 almost twice as long as article 2, with long lateral spine and 2 shorter medial spines.

Mandibles (Figs 1i, j). Incisor process with 4 cusps, lacinia mobilis of left mandible considerably broadening distally, almost half as long as incisor process, with 4 teeth, spine row with 11 and 12 members in left and right mandibles respectively, palp thin, slightly longer than mandibular body, article 2 is 3 times as long as article 1, with few distal setae, article 3 narrow, with numerous setules in inner surface and 5 stout distal setae.

Maxilla 1 (Fig. 1e). Inner lobe half as long as and narrower than outer lobe, the latter with 12 claw-like setae, some serrated.

Maxilliped (Fig. 1f). Basis with 7 coupling hooks, endite with 6 fan-setae and numerous thin setae distally, endite width 0.7 basis width, palp article 2 lateral length 1.4 article width, and the width 1.7 endite width, article 3 length 0.25 article 2 lateral length and 0.9 medial length, article 4 medial lobe and article 5 with 5 simple distal setae each. Epipod rounded distally, its length 2.7 width.

All percopods (Figs 2c–g, 3i, j) ambulatory, thin, similar, but first thinner and disproportionately smaller then others, their length gradually increase from 2 to 4 and then decrease to 7. Pereopods 1–4 bases subequal in length, slightly longer in percopods 5–7. All bases with row of small spines and plumose setae on dorsal margin each. Ischia of pereopod 1 and 5–7 less than half corresponding bases length (0.40, 0.42, 0.42, 0.47), in percopods 2–4 more than half (0.54, 0.56, 0.60). Ratios of lengths of carpi 1–7 : bases: 0.80, 1.20, 1.60, 1.82, 0.94, 0.79, 0.84 respectively; propodi : bases: 0.56, 1.05, 1.76, 1.96, 0.88, 0.82, 0.84; and dactyli : bases: 0.15, 0.66, 0.86, 0.96, 0.66, 0.64, 0.62. Carpi 5–7 slightly flattened and broaded, in percopod 7 less so. Ventral margins of carpi and propodi 5–7 with thin, unequally bifid setae, dorsal margins with small plumose setae. Dactyli 2–7 with numerous thin, simple dorsal setae.

Pleopod 1 (Fig. 3b) slightly tapering, its length 3.2 proximal width, midlength slightly narrowed, ventral surface lacking setae, but with small tubercules, distal lobes long, 30° to each other at distance 0.2 of protopod length from distal tip. Inner lobes of distal margin subrectangular with numerous thin long setae, outer lobes narrow, produced, slightly curved inward.

Pleopod 2 (Fig. 3c) length twice width, with dense row of plumose setae, endopod inserted at distance 0.6 of protopod length from basal margin, stylet 0.8 protopod length, well tapering distally, extending not far beyond distal margin of protopod, exopod extrinsic musculature occupying central part of protopod.

Pleopod 3 (Fig. 3d) length 0.8 pleopod 2 length, endopod subrectangular with 4 distal plumose setae, length twice width, exopod narrow, 2-segmented, longer than endopod, with 16 distal plumose setae and row of thin simple lateral setae.

Pleopod 4 (Fig. 3e). Endopod semicircular with acute distomedial tip, exopod length 0.8 endopod length and 0.5 endopod width, with 2 distal plumose setae.

Uropod (Fig. 2h) 0.82 pleotelson length. Protopod slightly broadening distally, with 1 long and 2 short distal setae, length 7.8 width. Endopod about half width of protopod and 0.8 protopod length, with 4 medial, 4 lateral strong unequal bifid setae and 5 plumose distal setae.

Female paratype. In appearance and structural details, the female is similar to the male. Antenna 1 (Fig. 3g) shorter than in male, with articles 2–5 thinner , flagellum of about 10 elongated articles. Pereonite 7 with ventromedial stout spine. Operculum (Fig. 3a) oval, length 1.3 width. Keel rounded ventrally, covered with small acute tubercules, distal part elevated and folded, lateral and distal margins with plumose setae.

Etymology. Hirsuta (Latin), hairy or shaggy, referring to the long, dense hairs on the body spines.

Remarks. The new species is most similar to *S. zenkevitchi.* The two species share the same number and arrangement of dorsal spines on pereonites, male pleopod 2 tapering distally, and 4 distal setae on the endopod of the pleopod 3 (all other species have 3 setae). The new species is distingished by longer body spines, longer terminal spine on the pleotelson, different length of the lateral spines of pleotelson and in having long, dense hairs on the body spines.

Storthyngurella wolffi sp. nov.

Figures 4–6

Material examined. Holotype. RV *Dmitrii Mendeleev*, cruise 16, stn 1349 (46°36.5′S, 144°04′E), 4464 m, ZMMU Mc 1318 (male, 9.1 mm long).

Paratypes. Type locality, ZMMU Mc 1319a (4 females, 6.8–10.7 mm long), NMV J45732 (1 male, 1 female). Stn 1285 (54°57.5′S, 163°51.3′E), 4590–4560 m, ZMMU Mc 1319b (1 male, 11 mm long) Stn 1299 (57°17′S, 157°13′ E), 5760–5460 m, ZMMU Mc 1319c (1 male, 12.3 mm long).

Description of holotype. Body (Figs 4a, b) length 3.2 times width, height 0.2 times length. Cephalon (Figs 4c, d) length 0.5 width, distance between antennae 1 0.12 cephalon width, frons concave medially, frontal arch low, clypeus twice as broad and half as long as labrum. Pereonites 1–4 with 1 dorsal medial long spine each. Anterolateral spines of pereonite 4 perpendicular to body axis, equal in length to pereonite medial length. Coxal spines of pereopods 1–4 almost twice as long as anterolateral spines of pereonite 4. Natasome 1.3 times as long as anterior body part. Pereonite 5 slightly longer than pereonites 6 and 7, the last 2 subequal in length, pereonites gradually narrowing from 5 to 7, their long anterolateral spines directed slightly forward. Pereonites ventral side with small acute medial spines.

Pleotelson pentagonal, separated by clearly visible suture, length 1.1 width, terminal spine almost straight, length 0.6 pleotelson length, lateral sides bearing 2 long spines subequal in length to terminal spine, and rectangular projection between them directed slightly down. Dorsal surface with 2 long medial spines and 2 short on sides and slightly behind posterior medial spines. Preanal ventral process of pleotelson long and broad, turned backwards, visible in dorsal view, with deep serrated medial notch and long lateral spines almost reaching tip of terminal spine. Lateral margins of pereonites with fine denticles, margins of pleotelson and body spines with prominent ones.

Antenna 1 (Fig. 6a) length 0.4 body length, article 1 elongated, 2.3 times as long as wide, article medial spine subequal in length to article, lateral lobe subequal in length to article 2. Article 2 length 0.3 article 1 length, with distal denticles, articles 3–5 length 1.6, 0.3, and 1.1 of article 2 length respectively, flagellum with many short articles, some with aesthetases.

Antenna 2 (Fig. 4a) almost twice as long as body. Basal articles 1–3 gradually lengthening, article 1 with long lateral spine almost twice as long as article width, article 2 twice as long as article 1, article 3 about 1.5 as long as article 2, with 1 lateral and 1 medial spines, article 4 shorter than article 3, length 0.6 width, article 5 twice as long as all preceding articles, article 6 slightly narrower and 1.2 times as long as article 5. Flagellum with approximately 110 elongated articles.

Mandibles (Figs 4e–g). Incisor process of left mandible broad and very thin, so curved that in frontal view looks narrow, with 4 cusps, lacinia mobilis broadening distally, almost half as long as incisor process, with 4 narrow dorsal and 1 broad ventral tooth, spine row with 13 and 14 members in left and in right mandibles respectively, molar process with 6 denticulated distal setae, palp thin, slightly shorter than mandibular body, first 2 articles equal in width, article 2 is 2.7 times as long as article 1, with 4 distomedial setae, article 3 with 7 large distal setae.

Maxilla 1 (Fig. 4i). Inner lobe width 0.6 outer lobe width, with 12 claw-like setae, some serrated.

Maxilliped (Fig. 4h). Basis with 7 coupling hooks, endite with 6–7 fan-setae and numerous thin setae distally, endite width 0.7 basis width,

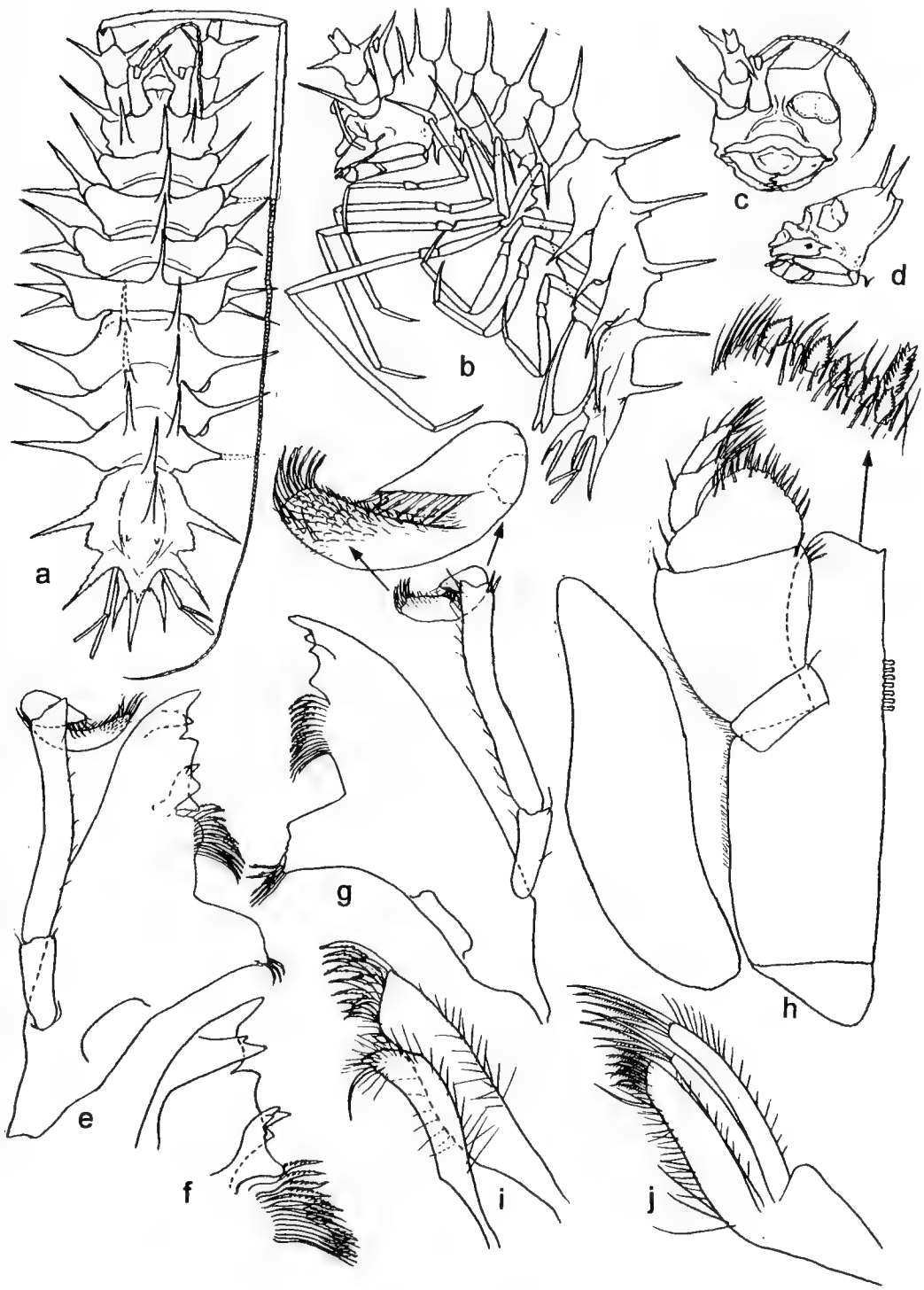

Figure 4. *Storthyngurella wolffi* sp. nov., male, holotype: a, b, dorsal and lateral views of body; c, d, frontal and lateral views of cephalon; e, left mandible; f, distal part of left mandible; g, right mandible; h, maxilliped; i, maxilla 1; j, maxilla 2.

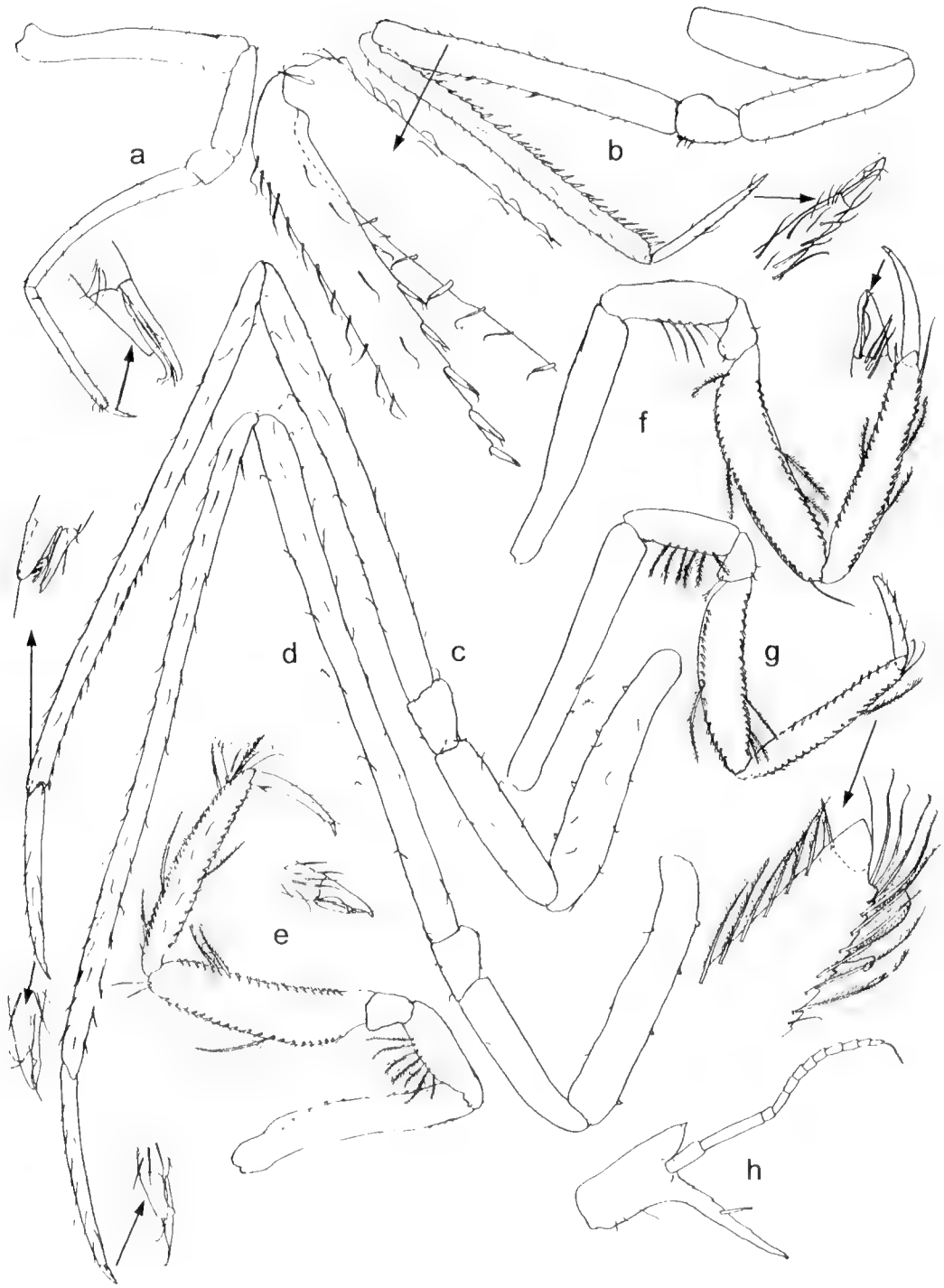

Figure 5. *Storthyngurella wolffi* sp. nov., male, holotype: a–g, pereopods 1–7; h, antenna 1 of female, paratype.

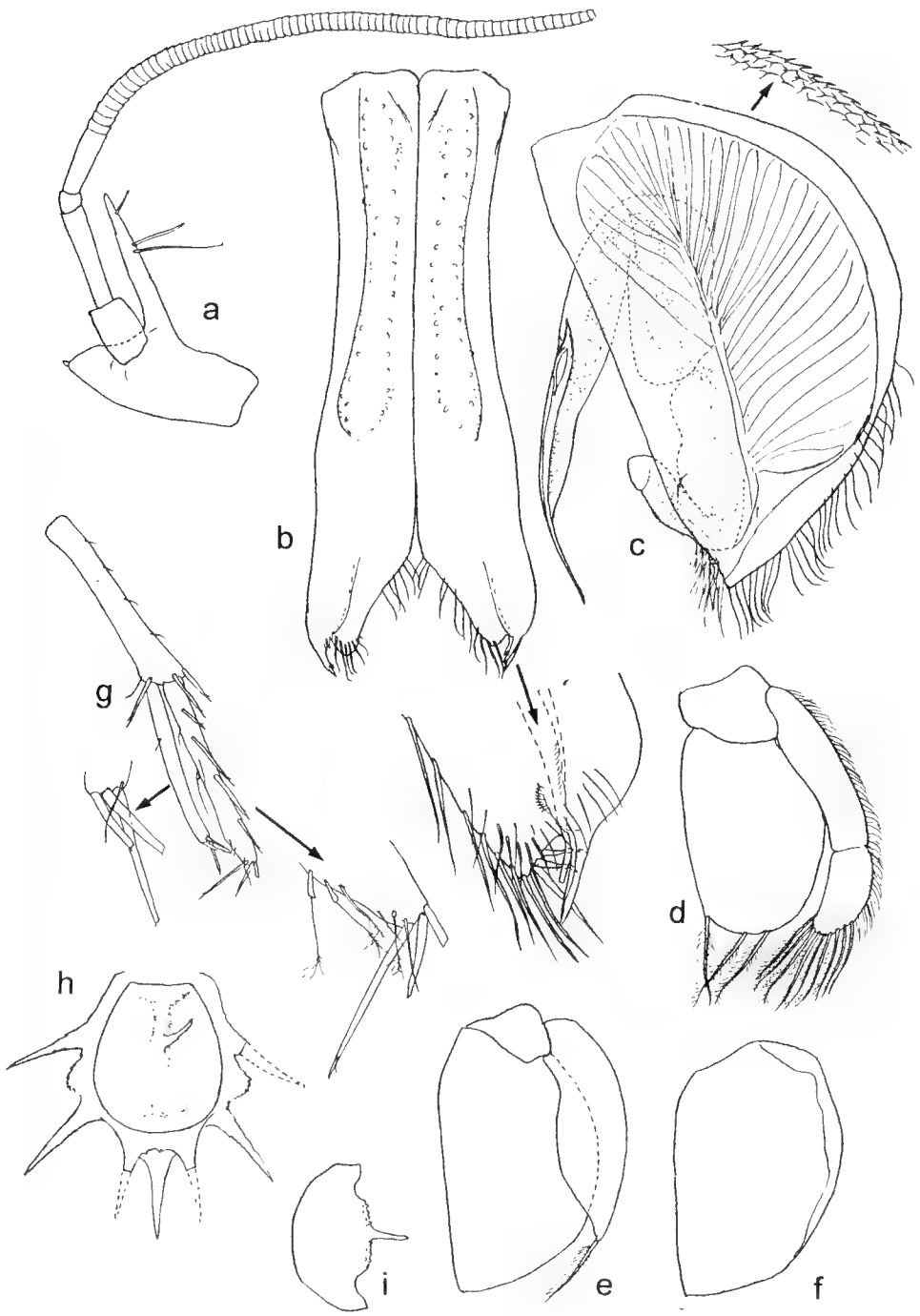

Figure 6. *Storthyngurella wolffi* sp. nov., male, holotype: a, antenna 1, b–f, pleopods 1–5; g, uropod; female, paratype: h, pleotelson, ventral view; i, operculum, lateral view.

lateral length of palp article 2 subequal to article width, and its width 1.7 endite width, article 3 length 0.24 article 2 lateral length and 0.8 medial length, article 4 medial lobe and article 5 with 7 simple distal setae each. Epipod rounded distally, 3 times as long as wide, lateral margin with smoothed midlength projection.

Pereopods 1–4 (Figs 5a–d) ambulatory, thin, similar in structure, first slightly smaller than second, pereopods 3 and 4 much longer than all other, pereopods 5–7 (Figs 5e–g) subequal in size and shape. All pereopod bases subequal in size, in pereopods 1–4 they are broadest articles. All bases with small and sparse setae only. Ischia of pereopods 1 and 5–7 about half of corresponding bases length (0.46, 0.48, 0.51, 0.42), and more than half in pereopods 2–4 (0.79, 0.66, 0.66). Ratios of lengths of carpi 1–7 : bases: 0.86, 1.34, 1.61, 1.95, 0.94, 0.90, 0.67 respectively; propodi : bases: 0.63, 1.57, 2.04, 2.42, 0.97, 0.95, 0.72; and dactyli : bases: 0.1, 0.6, 0.91, 0.79, 0.41, 0.4, 0.32. Carpi 5–7 flattened and slightly broadened, length about 4 times width, propodi 5–7 length 7.1, 6.5, 6.4 width respectively, both margins of carpi and propodi 5–7 and dorsal margin of ischia 5–7 with thin short plumose setae. Dactyli 2–7 with numerous thin, simple dorsal setae.

Pleopod 1 (Fig. 6b) relatively broad, broadening distally, length 2.7 proximal width, ventral surface lacking setae, but with small high tubercules, distal lobes 70° to each other at distance 0.2 of pleopod length from distal tip. Inner lobes of distal margin subrectangular with numerous thin, long setae, outer lobes narrow, projecting, slightly curved inward.

Pleopod 2 (Fig. 6c) length 1.6 width, endopod inserted 0.6 protopod length from basal margin, stylet 0.9 protopod length, strongly tapering distally, not extending beyond distal margin of protopod, exopod extrinsic musculature occupying bulk of protopod, coming close to lateral margin. Pleopods 1 and 2 much larger and thicker than remainder.

Pleopod 3 (Fig. 6d) length 0.6 pleopod 2 length, endopod subrectangular, length 1.4 width, with 3 distal plumose setae, exopod narrow, slightly longer than endopod, with 9 distal plumose setae and row of thin simple lateral setae.

Pleopod 4 (Fig. 6e). Endopod semicircular with acute distomedial tip, exopod length 0.8 endopod length and 0.5 endopod width, with 1 distal seta.

Uropod (Fig. 6g) 0.86 pleotelson length, extending beyond terminal spine of pleotelson. Protopod slightly broadening distally, with 4 medial setae, length 4.3 width. Endopod about half width of protopod and slightly shorter (0.97), with 4 medial, 4 distal unequal bifid setae, and 1 plumose lateral seta, exopod slightly narrower than endopod, its length 0.8 endopod length, with 3 distal unequal bifid setae.

Female paratype. In appearance and structural details, the female is similar to the male. Antenna 1 (Fig. 5h) almost half as long as in male, article 1 length 2.2 width, medial spine subequal in length to article, articles 2–5 length ratio almost same as in male, article 2 subequal in width to following articles, flagellum with 8 elongated articles. Operculum (Figs 6h, i) oval, length 1.3 width. Keel rounded ventrally, covered with small acute tubercules with long, stout spine in midlength, lateral and distal margins with plumose setae.

Etymology. The species is named after the outstanding Danish carcinologist, Prof. Torben Wolff.

Remarks. The specimens varied little. Lateral spines of the preanal process are broken in all specimens except the holotype. The new species is identified as *Storthyngurella* by the combination of the following features: long spines on the body, coxae 1–4, and basal articles of both antennae; long terminal spine and preanal process on the pleotelson; narrow carpi and propodi of pereopods 5–7; shape of male pleopods 1 and 2; armament of pleopods 3; and long uropods. But *S. wolffi* is distinguished from the other species of the genus by unusual shape of pleotelson and 1 (not 3) dorsal spine on pereonites 2–4. The only other species with 1 dorsal spine on pereonites 2–4 is *S. benti*, but pleotelson shape in this species is common for the genus. The presence of two lateral spines on pleotelson makes *S. wolffi* similar only to *S. digitata*, but spines on the pleotelson and pereonites of the latter species are different.

Storthyngurella menziesi sp. nov.

Figures 7, 8

Material examined. Holotype. Argentine Basin, RV *Dmitrii Mendeleev*, cruise 43, stn 4109 (38°40′S, 48°08′W), 5225 m, ZMMU Mc 1320 (male, 10.2 mm long).

Paratypes. Type locality, ZMMU Mc 1321a (2 males, 9.2, and 9.4 mm; 1 female, 11.2 mm; fragments of 6 specimens), NMV J45734 (1 male, 1 female), RV *Akademik Kurchatov*, cruise 11, stn 858 (48°52′S, 26°34′W), 4560–4570 m, ZMMU Mc 1321b (1 female, 14.3 mm long).

Description of the holotype. Body (Figs 7a, b) length 3.2 times width, height 0.15 times length.

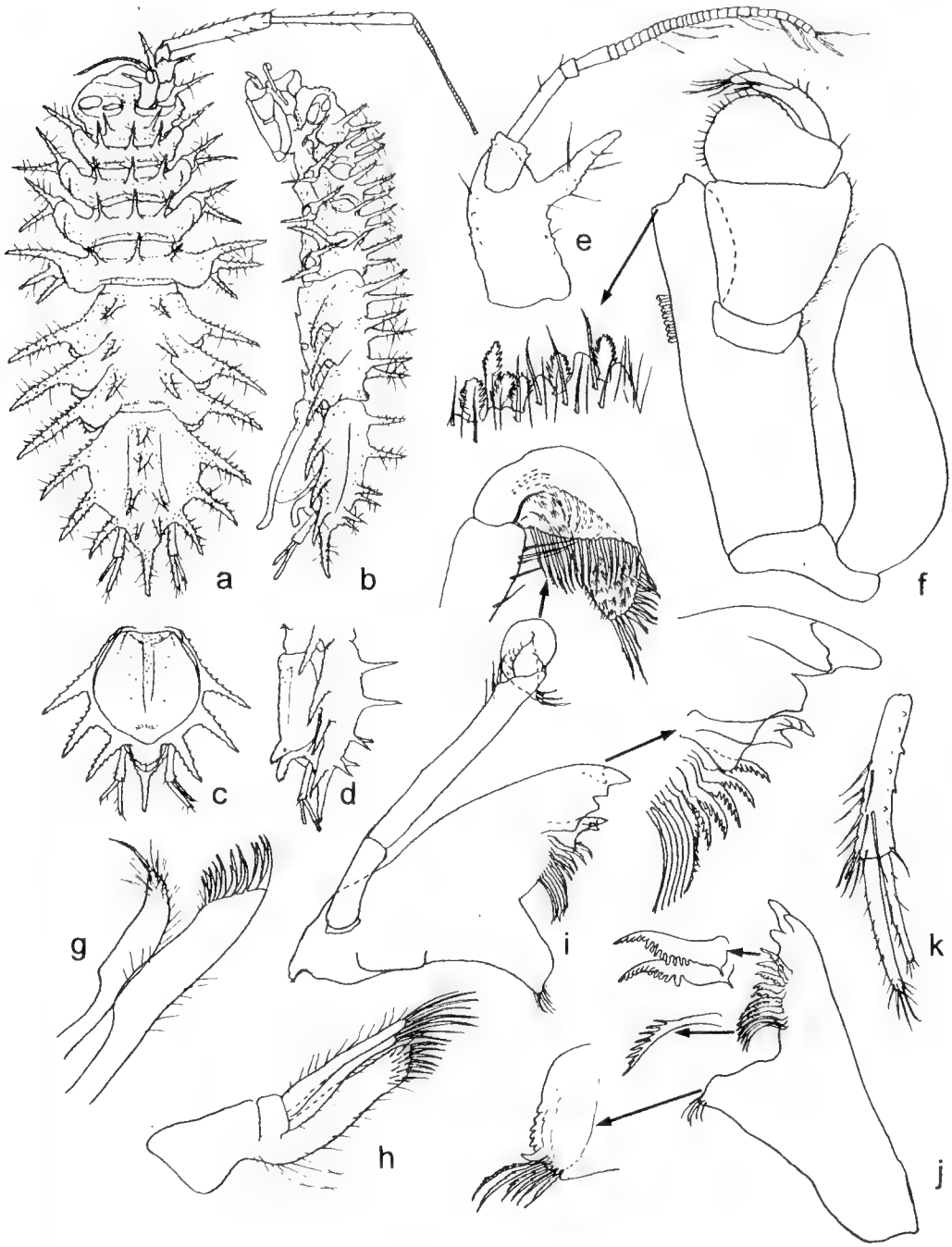

Figure 7. *Storthyngurella menziesi* sp. nov. a, b, f–k, male, holotype; c–e, female, paratype. a, b, dorsal and lateral views of body; c, d, pleotelson, ventral and lateral views; e, antenna 1; f, maxilliped; g, maxilla 1; h, maxilla 2; i, left mandible; j, right mandible; k, uropod.

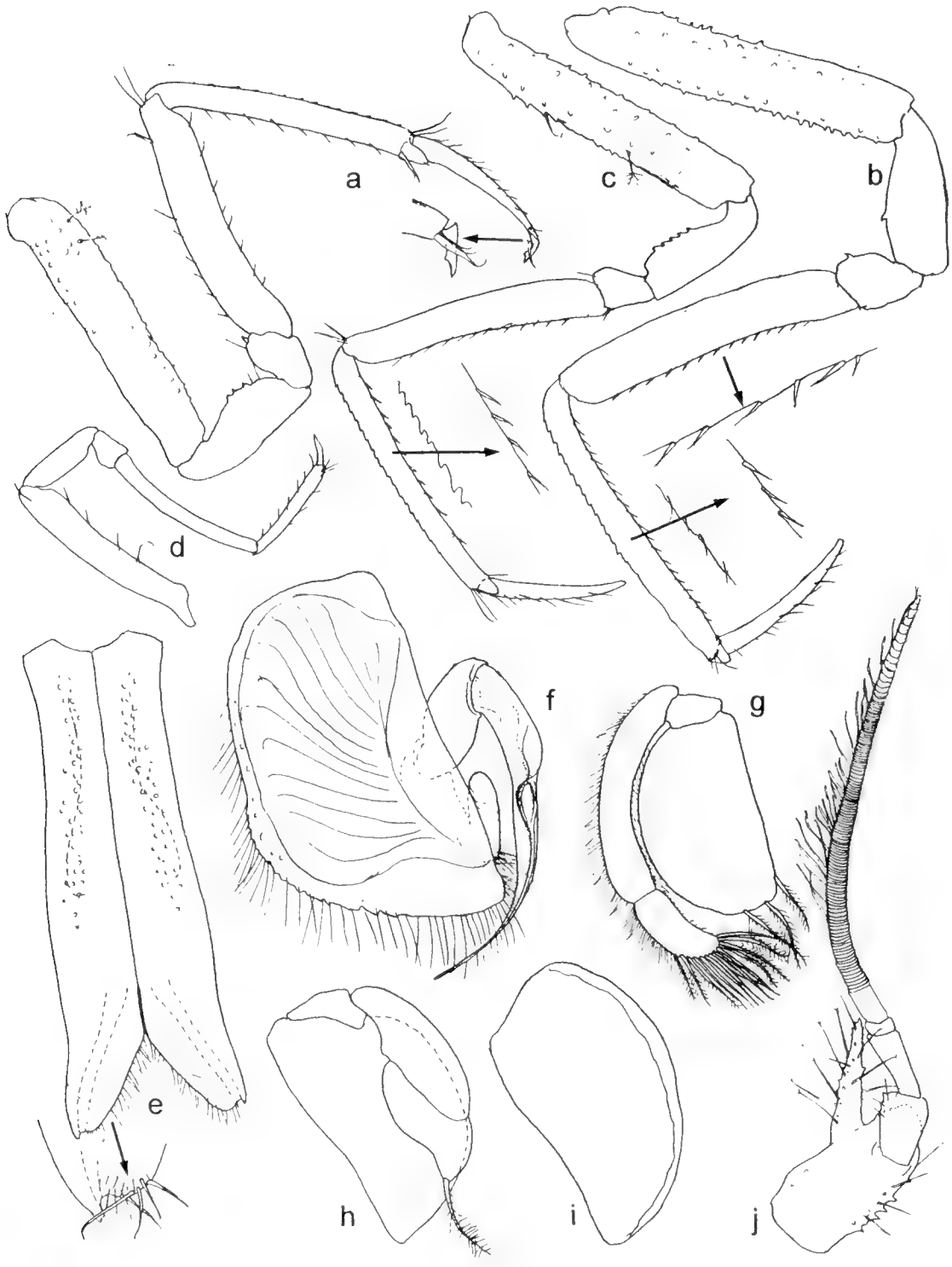

Figure 8. *Storthyngurella menziesi* sp. nov., male, holotype: a–c, pereopods 5–7; d, pereopod 1; e–i, pleopods 1–5; j, antenna 1.

Cephalon length 0.5 width, distance between antennae 1 is 0.15 cephalon width, antennal sockets well marked, frons slightly concave medially, clypeus 1.75 times as broad and half as long as labrum. Pereonite 1–4 with 3 dorsal long spines. Anterolateral spines of pereonite 4 perpendicular to body axis, equal in length to half of pereonite width. Coxal spines of pereopods 1–4 shorter than anterolateral spines of pereonite 4. Natasome 1.3 times as long as anterior body part. Pereonites 5–7 subequal in size, their anterolateral spines long, directed slightly backward.

Pleotelson triangular, length 1.1 width, terminal spine straight, length 0.35 pleotelson length, lateral sides with 3 long subequal spines directed backward, parallel to lateral spines of pereonites 5–7. Anterior part of pleotelson with 2 long dorsal medial spines, posterior part with 2 pairs of shorter spines. Preanal ventral process of pleotelson broad, semicircular, turned backwards, in ventral view almost completely covering anal operculum. Body surface covered by small acute tubercules, all spines on body, coxae and antennae with long hair-like setae.

Antenna 1 (Fig. 8j) length 0.25 body length, article 1 elongate, 2.2 times as long as wide, article medial spine 1.6 times as long as article width, lateral lobe extends almost to distal tip of article 2. Article 2 with 2 distal setae, length 0.4 article 1 length, article 3 5 lengths 1.1, 0.3, 0.9 article 2 length respectively, flagellum with numerous short articles, some with aesthetases.

Antenna 2 (Fig 7a). Basal articles 1–3 gradually lengthening, long lateral spine of article 1 subequal in length to coxal spines of pereopods 1–4, article 2 distinctly longer than article 1, article 3 subequal in length to article 2, with 1 lateral and 1 medial spines, article 4 half as long as article 3, length 0.6 width, article 5 twice as long as total length of all preceding articles, article 6 slightly narrower and 1.4 times as long as article 5. Flagellum with elongate articles, most broken off.

Mandibles (Figs 7I, j). Incisor process of both mandibles with 4 cusps, lacinia mobilis broadening distally, almost half as long as incisor process, with 5 teeth, spine row with 12 and 13 members in left and right mandibles respectively, molar process tip denticulated, with 6 setulose distal setae, palp 1.2 times as long as mandibular body, first 2 articles equal in width, article 2 twice as long as article 1, with 4 distomedial setae, article 3 with setae row on medial margin.

Maxilla 1 (Fig. 7g). Inner lobe width 0.7 outer lobe width, with 13 claw-like setae, some serrated.

Maxilliped (Fig. 7f). Basis with 8 coupling hooks, endite with 6 fan-setae distally, endite width 0.6 basis width, lateral length of palp article 2 almost equal to article width, its width twice endite width, article 3 length 0.3 article 2 lateral length and 0.7 medial length, medial margin with 17–18 stout setae, article 4 medial lobe and article 5 with 5 simple distal setae each. Epipod rounded distally, lateral margin semicircular, length 2.3 width.

Pereopods 2–4 broken, only bases present. Pereopods 1–4 bases subequal in length, those of pereopods 5 7 slightly longer, all bases with row of small spines and plumose setae on dorsal margin. Pereopod 1 (Fig. 8d) almost half as long as pereopods 5–7, pereopods 5–7 (Fig. 8a–c) subequal in size and shape, with tubular articles, pereopod 6 longest. Ischia of pereopods 1 and 5–7 about half corresponding basis length (0.43, 0.50, 0.48, 0.41). Ratio of lengths (pereopods 1 and 5–7) carpi : bases: 0.76, 0.87, 0.84, 0.81 respectively; propodi : bases: 0.48, 0.87, 0.90, 0.86; and dactyli : bases: 0.15, 0.56, 0.51, 0.47. Carpi 5–7 slightly and propodi half as wide as bases. Ventral margins of carpi and propodi 5–7 with thin, short unequal bifid setae, dorsal margins denticulated, with thin short simple setae. Dactyli with numerous thin simple dorsal setae.

Pleopod 1 (Fig. 8e) relatively broad, broadening distally, length 2.8 distal width, ventral surface lacking setae, but with small high tubercules, distal lobes 70° to each other at distance 0.2 protopod length from distal tip. Inner lobes of distal margins semicircular, with numerous thin long setae, outer lobes narrow, expanded, slightly curved inward.

Pleopod 2 (Fig. 8f) length 1.7 width, endopod insert in midlength of protopod medial margin, stylet subequal in length to protopod, strongly tapering distally, extending beyond distal margin of protopod, exopod extrinsic musculature extending almost throughout protopod. Pleopods 1 and 2 much larger and thicker than remaining ones.

Pleopod 3 (Fig. 8g) length 0.6 pleopod 2 length, endopod subrectangular, length 1.4 width, with 3 distal plumose setae, exopod narrow, width 0.3 endopod width, 1.6 times as long as endopod, with 9 distal plumose setae and row of thin simple marginal setae.

Pleopod 4 (Fig. 8h). Endopod semicircular, exopod 2-articulated, length 0.8 endopod length and width 0.6 endopod width, with 1 distal setae.

Uropod (Fig. 7k) 0.46 pleotelson length, extending slightly beyond terminal spine of pleotelson. Protopod slightly broadening distally, with

8 medial and 6 distal setae, length 4.2 width. Endopod 0.4 width of protopod and slightly shorter (0.97), with row of small medial and 6–7 distal unequal bifid setae, exopod slightly narrower than endopod, its length 0.8 endopod length, with 3 distal unequal bifid setae.

Female paratype. In appearance and structural pattern, the female is similar to the male. Antenna 1 (Fig. 7e) about 1.5 times shorter than in male, article 1 length 2.1 width, medial spine length 0.65 article length, articles 2–5 length ratio similar to that of male, flagellum with about 30 elongate articles. Operculum (Figs 7c, d) oval, length 1.1 width. Keel rounded ventrally, covered with small acute tubercules, distal part turned upward.

Etymology. The species is named after the late outstanding American carcinologist Dr Robert Menzies who described, among others, many species of the genus *Storthyngura*.

Remarks. The new species is most similar to *S. triplispinosa* by body shape, number and arrangement of body spines, and tubular last three pairs of legs lacking natatory setae. The major difference between the species is the number of dorsal spines on the pleotelson: six in the new species and four in *S. triplispinosa*. *S. menziesi* is also distinguished by more slender body (body length is 3.2 times body width in the new species and 2.8 times in *S. triplispinosa*); and a longer exopod of uropod (endopod to exopod length ratio is 1.21 in the new species and 1.64 in *S. triplispinosa*). Both *S. benti* and *S. zenkevitchi* have a similar shaped pleotelson with three lateral spines and a relatively short terminal spine but these species have different numbers and arrangements of dorsal spines on the pleotelson: *S. benti* has two medial spines and a pair of tubercules on both sides of posterior spine, and *S. zenkevitchi* has one dorsal medial spine on the anterior part of the pleotelson and three tubercules in posterior part.

Storthyngurella triplispinosa (Menzies, 1962) comb. nov.

Figures 9, 10d

Storthyngura triplispinosa Menzies, 1962: 149, fig. 38A–E. — George and Menzies, 1968a: 177. — George and Menzies, 1968b: 298, fig. 12B.

Material examined. Argentine Basin, RV *Dmitrii Mendeleev*, cruise 43, stn 4094 (60°42′S, 41°03′W), 4670 m (pleotelson of female); stn 4086 (60°50′S, 41°10′W), 6130–6420 m (female, 6.4 mm long; fragments of 2 specimens); stn 4090 (60°52′S, 40°56′W), 6145–5550 m (fragments of 2 specimens); RV *Akademik Kurchatov*, cruise 11, stn 914 (56°21′S, 50°48′W), 5650–6070 m (anterior part of female with oostegites); cruise 43, stn 4904 (32°10′S, 63°05′W), 3880–3930 m (1 male, 7.5 mm long).

Remarks. These specimens were identified as *S. triplispinosa* only on the basis of external similarities with holotype drawings; there was no opportunity to compare my specimens with type material. Besides the dorsal view of an entire specimen, Menzies presented only drawings of some details: antenna 1, pereopod 1, distal part of pleopod 1 and uropod. These details in my specimens are the same. Here I provide drawings of other appendages.

Storthyngurella digitata (Menzies, 1962) comb. nov.

Figure 10e

Storthyngura digitata Menzies, 1962: 146, figs 37 F–C.

Material examined. Argentine Basin, RV *Dmitrii Mendeleev*, cruise 43, stn 4109 (38°40′S, 48°08′W), 5225 m (1 female without pleotelson); RV *Akademik Kurchatov*, cruise 43, stn 4893 (36°12′S, 49°10′W), 4630 m (1 female, 6.5 mm; 1 male 6.8 mm long).

Remarks. Although the body processes of *S. digitata* are neither long nor spine-like, but bulbous, and the pleotelson does not have a long terminal spine, this species is placed in *Storthyngurella* because of the typical arrangement of processes on the body, the first articles of both antennae, narrow carpi and propodi of pereopods 5–7, the morphology of first pairs of male pleopods, and three distal setae on the endopod of pleopod 3.

Acknowlegements

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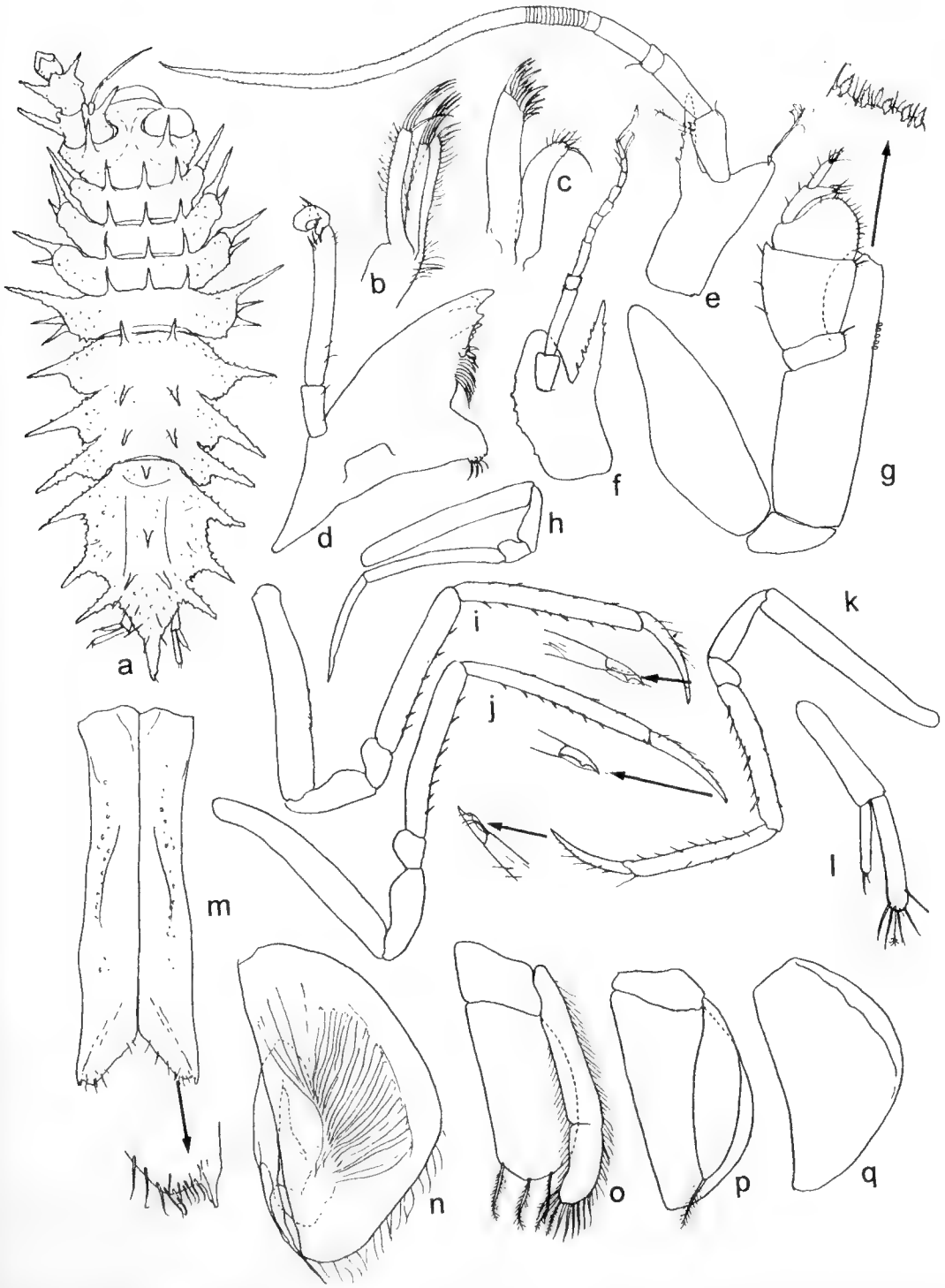

Figure 9. *Storthyngurella triplispinosa* (Menzies, 1962). All except f, male from stn 4904: a, dorsal view of body; b, maxilla 2; c, maxilla 1; d, left mandible; e, antenna 1; f, antenna 1 of female from stn 4904; g, maxilliped; h, pereopod 1; i–k, pereopods 5–7; l, uropod; m–q, pleopods 1–5.

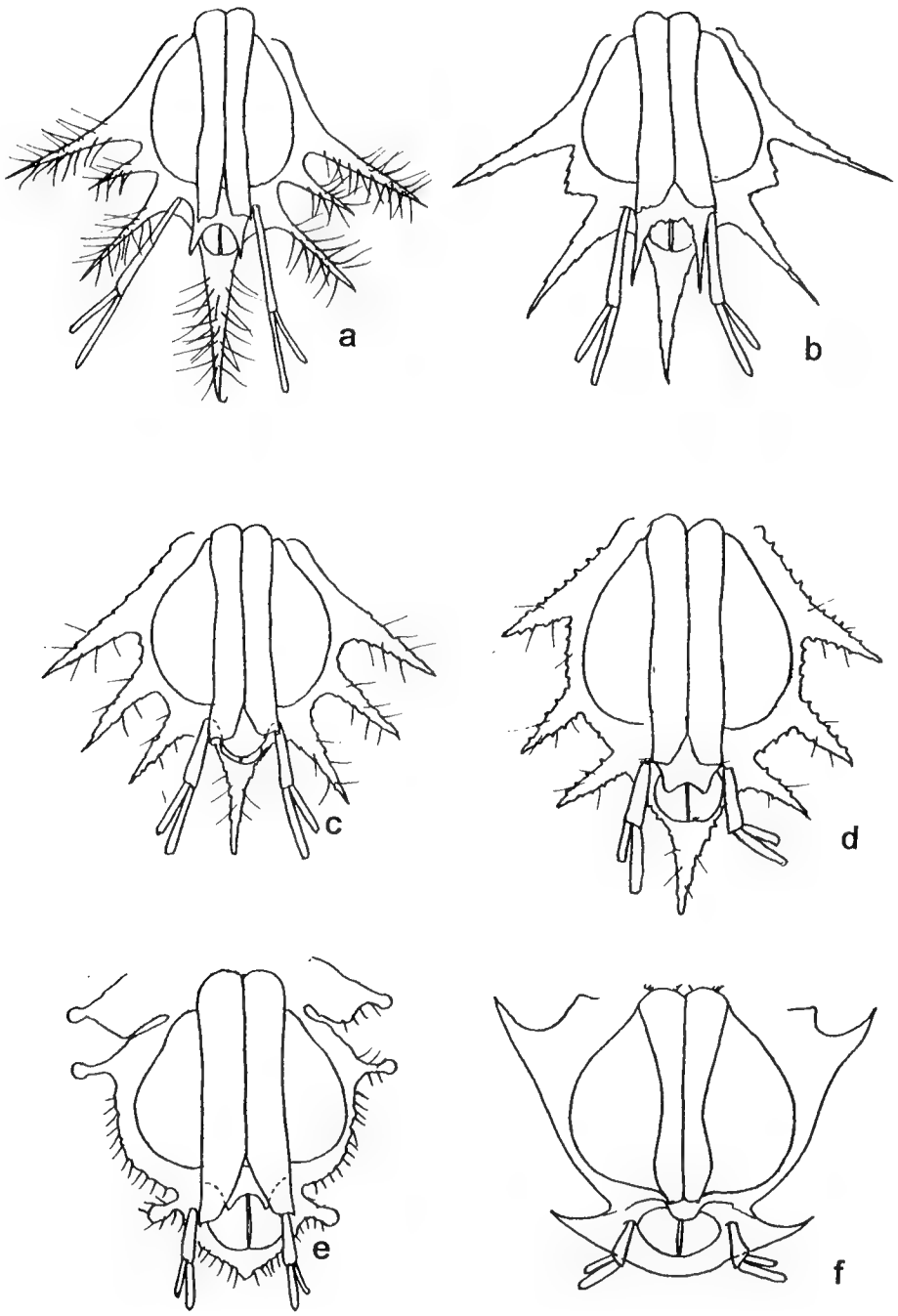

Figure 10. Structure of male operculum in five species of *Storthyngurella* gen. nov. and one species of *Storthyngura:* a, *Storthyngurella hirsuta* sp. nov. ; b, *S. wolffi* sp. nov.; c, *S. menziesi* sp. nov.; d, *S. triplispinosa* (Menzies, 1962); e, *S. digitata* (Menzies, 1962); f, *Storthyngura birsteini* Menzies, 1962.

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Memoirs of Museum Victoria 57(2): 287–310 (1999)

REVISION OF LAPHYSTIOPSIDAE (CRUSTACEA: AMPHIPODA): NEW AND OLD SPECIES FROM SOUTH CHINA SEA, SOUTHEASTERN AUSTRALIA, FALKLAND ISLANDS AND WESTERN ATLANTIC OCEAN

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Abstract

Barnard, J.L., 1999. Revision of Laphystiopsidae (Crustacea: Amphipoda): new and old species from South China Sea, southeastern Australia, Falkland Islands and western Atlantic Ocean. *Memoirs of Museum Victoria* 57: 287–310.

Collections from Bass Strait and eastern Tasmania reveal two new species of *Laphystiopsis*, *L. wulgi* sp. nov., and *L. zomerysis* sp. nov. of the rarely encountered family Laphystiopsidae. To verify differences between *Prolaphystiopsis* and the type of the family, *Laphystiopsis*, old but unreported materials of *Laphystiopsis planifrons* Sars in the Smithsonian's National Museum of Natural History collections were reviewed and are presented herein. *Prolaphystiopsis platyceras*, type of the genus, was borrowed and redescribed. Sars' (1895) and Schellenberg's (1931) differentiation of the genera was based on erroneous observations of the palp of maxilla 1. A review of the family is presented, with updating of diagnoses and literature. *Prolaphystiopsis* differs from *Laphystiopsis* in the narrow rostrum, bulging head, and enlarged and lobate article 1 of antenna 1. *Laphystiopsis planifrons* is newly recorded from the western Atlantic Ocean. *Laphystiopsis iridometrae* Shoemaker, 1919 from the South China Sea is reviewed and illustrated for the first time. *Prolaphystiopsis latirostris* Ledoyer, 1986 is removed to *Laphystiopsis*. Individuals of the family are presumed to be inquiline parasites or commensals of sessile marine invertebrates, particularly crinoids, but are rarely noticed by amphipodologists.

Introduction

While examining amphipods from Bass Strait in Museum Victoria, Jean Just discovered a specimen of Laphystiopsidae, a family rarely collected. Later [in 1990] I visited him and Gary Poore at Museum Victoria and continued sorting through similar collections and found one more specimen from eastern Tasmania. The two specimens are reported on here as two new Australian species.

The remarkable morphological resemblance of *L. zomerysis* sp. nov. and *L. wulgi* sp. nov. to the North Atlantic *Laphystiopsis planifrons* Sars, 1895 in somatic aspect and the perfunctory generic distinction (1- or 2-articulate palp of maxilla 1) between *Laphystiopsis* and *Prolaphystiopsis* necessitated reexamination of specimens of *L. planifrons* to verify the uniarticulate condition of the palp on maxilla 1, and to search for other generic differences. In this examination, *L. planifrons* was found to occur in the western Atlantic Ocean. Maxilla 1 palp proved to be 2-articulate despite the analysis of Sars (1895). Thus, the only known difference between *Prolaphystiopsis* and *Laphystiopsis* evaporated. After examining the syntypes of *Prolaphystiopsis platyceras*, type species of the genus, it was determined that the narrow rostrum, bulging head, and enlarged and lobate article 1 of antenna 1 are new characters that diagnose *Prolaphystiopsis*. *Laphystiopsis ornitorhynchus* Bulycheva is transferred to *Prolaphystiopsis*.

Review of the scant literature of this family revealed that *Laphystiopsis iridometrae* Shoemaker, 1919 from the "China Sea" had been only briefly described but never illustrated. The holotype deposited in Smithsonian collections provided a detailed analysis of that species. Although more than 20 juveniles were also present in the Smithsonian collections, only the holotype was fully adult.

* Jerry Laurens Barnard died on 16 August 1991 shortly after completing a first draft of this manuscript. The editor thanks Elizabeth Harrison-Nelson for sending the paper to the *Memoirs of Museum Victoria* as Jerry had intended. J.D. Thomas, J.K. Lowry, J. Just and I made corrections and improvements to the original draft but these have been slight. Gary C. B. Poore

Species in Laphystiopsidae are assumed to be "parasites" on other organisms, much in the same manner that Lafystiidae (Sars, 1895; Bousfield, 1987) are parasitic on fish. Indeed, *L. iridometrae* was originally found by Dr Austin H. Clark embedded in tissues of the crinoid *Iridometra melpomene* (*Iridometra adrestine* [A.H. Clark]) and given to Shoemaker who described it sparingly. If not for the excellent work of Bousfield (1987), in collecting and soliciting specimens of Lafystiidae from fish, very little would be known of its presumed sister family. Because they have been collected secondarily from their hosts, laphystiopsids appear in amphipod collections only accidentally. Commensal amphipods that cling to the host initially on collection can be easily lost during routine curatorial activities, e.g., alcohol and/or container changes. For a more complete understanding of the group, active searches should be undertaken focusing especially on sessile or slow moving invertebrates such as gorgonians and crinoids.

Each species is diagnosed; the drawings form the principal descriptive material; the descriptions for each are composed only of comments amplifying the drawings. Diagnoses and descriptions are not congruous among species. The diagnosis of the family is based on new observations, not all of which have been confirmed in all species of the family. Geographic codes listed in brackets for each species taken from Barnard and Karaman (1991). Length and width of coxae are the same as length and width of any article on the pereopods; the words deeper and broader are not appropriate.

Material is deposited in Museum Victoria, Melbourne (NMV) and National Museum of Natural History, Smithsonian Institution, Washington (USNM).

Laphystiopsidae Stebbing, 1899

Diagnosis. Rostrum present or absent, if present well developed, reaching at least halfway along peduncular article of antenna 1. Accessory flagellum absent or uniarticulate. Field of mouthparts quadrangular. Mandibular molar scarcely triturative or not, rakers absent or 1 raker present. Inner plate of maxilla 1 feeble, poorly setose (1 seta or naked), outer plate with 5–7 spines; palp large, 2-articulate. Palp of maxilliped 4-articulate. Coxae 1–4 small, quadrate or anteroposteriorly rectangular or ovate, occasionally disjunct from each other. Gnathopods 1–2 feeble, simple. Urosomites free. Uropod 3 biramous, outer ramus longer than peduncle. Telson short, entire.

Description. Body broad, depressed, weakly to strongly carinate on pleonites 3–4 or 1–3 only. Urosome slightly flattened, urosomite 1 elongate or not. Head flat, rostrum large and spatulate [or absent]; eyes present or absent; sides of head bulging or not. Antenna 1 dominant, peduncle short, flagellum elongate, article 1 of flagellum pubescent or not or developed as a weak callynophore; antenna 2 often as long as antenna 1 but of lesser thickness and lesser dominance. Mouthparts generally feebly armed. Upper lip broad, incised. Mandibular incisors ordinary, not attenuate for piercing, toothed; palp well developed, 3-articulate, very poorly setose, armaments mostly scales. Inner lobes of lower lip fleshy and well developed or absent. Inner plate of maxilla 1 small, ovate, with 1 small seta or none, outer plate with 5 spines; palp 2-articulate (but see the discussion of *Prolaphystiopsis ornitorhynchus* below). Plates of maxilla 2 narrow, inner setose medially or not. Maxillipeds small, feebly armed, plates ordinary except basal article of outer plate elongate; palp large or small. Coxae variable, short and evenly extending or middle coxae longer, occasionally coxae so small as to be disjunct. Gnathopods simple, carpi elongate. Pereopods 5–7 increasingly elongate or not, article 2 increasingly expanded. Epimeron 2 dominant. Pleopod 3 significantly shorter than pleopods 1–2. Uropods 1 and 3 exceeding uropod 2 (as far as known), outer rami slightly shortened or not; peduncle of uropod 3 scarcely elongate. Telson ovate.

Variables. Prolaphystius departs from the typical characterization in the total absence of a rostrum, lack of inner lobes on the lower lip, larger middle coxae, excavate coxa 4, long carpus of pereopod 3, lysianassid-like pereopods 5–7, elongate telson, and elongate urosomite 1. Specimens of this antarctic genus have not been observed; it may belong in another family. It keys out to the generalized "melting pot" of Eusiridae but differs from that group in the reduction of spines on the outer plate of maxilla 1 to 5 (versus generally 9–11), the feeble palp of the maxilliped, the elongated article on which the outer plate of the maxilliped is attached; the reduction of raker spines to 1 (versus generally 5+), and the elongation of urosomite 1.

Relationship. See Barnard and Karaman (1991) for comparisons with the families: Iphimediidae; Lafystiidae; Eusiridae (Calliopiidae, Pleustidae); Oedicerotidae; Stilipedidae; Astyridae; Colomastigidae; Maxilliphimediidae. The family differs from Lafystiidae in the 4-articulate (versus 2-articulate) palp of the maxilliped, the reduction of spines on the outer plate of maxilla 1 from 7 to 5, the presence of a molar, and well developed palp on maxilla 1, and except for *Prolaphystius*,

the presence of inner lobes on the lower lip, and the poorly developed and poorly setose (1 versus 2+ setae) inner plate of maxilla 1.

The Laphystiopsidae are similar to the Eusiridae, Calliopiidae and Pleustidae but with feeble, simple gnathopods; feeble, and poorly setose maxillipedal palps. The lower lip of the type genus is like the characteristic labium of Pleustidae, and the inner lobes of *Laphystiopsis* are large and fleshy, whereas the inner lobes are lost in *Prolaphystius*.

Like the Lafystiidae, the Laphystiopsidae may have some roots in Iphimediidae. Lafystiidae have an acuminate coxa 4 and otherwise are similar to the Iphimediidae except for the reduced palp on the maxilliped. The Laphystiopsidae are so diverse that they must be characterized individually. *Laphystiopsis* and *Prolaphystiopsis* differ from Iphimediidae in the very short nonacuminate coxae and flattened (though strongly rostrate) head; *Prolaphystius* differs in the nonrostrate head and thin geniculate urosome.

The Stilipedidae and Astyridae bear large outer lobes on the maxillipeds and strongly dominant carpi on the gnathopods.

All but one genus of Oedicerotidae have elongate peduncles on uropod 3, and that genus, *Metoediceros*, like other oedicerotids, has slightly or strongly subchelate gnathopods, a disproportionately elongate pereopod 7, strongly setose pereopods, and unnotched upper lip.

Corophioids have triturative molars and usually subchelate or strongly setose and specialized gnathopods.

The Laphystiopsidae could be confused with Phoxocephalidae that have an elongate, flat, spatulate rostrum, but Laphystiopsidae differ in the non-fossorial pereopods and antennae, and the large biramous uropod 3 lacking article 2 on the outer ramus (occasionally true in Phoxocephalidae, but only with short uropod 3), the small coxae, the weak antenna 2 and the uncleft telson.

The uniformity of Laphystiopsidae is broken by the loss of the rostrum in *Prolaphystius*. That genus has a long urosomite 1 as in Dulichiidae, but otherwise has little similarity to that family.

The Laphystiopsidae are analagous to Maxillipiidae in that both are inquilinous on sessile or semi-sessile invertebrates. Maxillipiidae occupy gorgonians (Thomas, 1996) while the Laphystiopsidae are definitely known from crinoids but possibly also from coelenterates (collected in fields of *Lophelia* in Norway). The two families resemble each other in what may be superficially convergent characters as follows: similar coxal shapes, bulging ocular regions, presence of callynophore, feeble maxillae and maxillipeds, feeble gnathopods, huge oostegites, and weak telson (except *Prolaphystius*). In contrast, the Maxillipiidae are characterized by an enormously elongate pereopod 6, serrate spines on outer plate of maxilla 1, thickened article 2 of maxilliped palp, elongate peduncle of uropod 3, unnotched upper lip, and one or both mandibles with 2+ slender rakers. Maxillipiids are free-living on gorgonians where they gather in large numbers with their elongate sixth pereopods stretched outward laterally and frequently rotating whereas the only known ecological observation of laphystiopsids is that they make surficial burrows on crinoids.

Key to genera of Laphystiopsidae

1. Rostrum absent; coxa 4 almost as long as broad, deeply excavate posteriorly ..... *Prolaphystius*
   Rostrum elongate, apex exceeding first peduncular segment; coxa 4 small, much wider than long, not excavate posteriorly 2
2. Article 1 of antenna 1 enlarged, lobate; rostrum apically constricted, margin rounded; eye lobes strongly bulging ..... *Prolaphystiopsis*
   Article 1 of antenna 1 not enlarged or lobate, lacking apical projection; rostrum not constricted, truncate; eye lobes not bulging ..... *Laphystiopsis*

Laphystiopsis Sars

Laphystiopsis Sars, 1895: 386.

Type species. Laphystiopsis planifrons Sars, 1895 (monotypy).

Diagnosis. Rostrum well developed, very broad; ocular lobes not bulging. Article 1 of antenna 1 not grossly lobate. Mandibular molar conical, unridged. Inner lobes of lower lip present. Palp of maxilla 1 uniarticulate. Coxae short, broad, anterior coxae ovate, often not touching serially, coxa 4 much wider than long, not excavate posteriorly. Pereopods 3–4 alike, with carpus very short. Pleonite 3 dorsally carinate but not forming horizontal shelf, urosomite 1 carinate and saddled. Telson short, oval.

Description. Article 1 of antenna 1 weakly carinate to strongly produced apically and massive.

Coxae produced forward or not. Articles 2–7 of pereopod 3 like pereopod 4. Pleonites 3–4 carinate and pleonite 4 saddled, or only pleonites 1–3 carinate.

Included species.

L. iridometrae (Shoemaker, 1919) (Vader, 1978), near Hong Kong, inquilinous [6521]

L. latirostris Ledoyer, 1986, Geyser Bank, Indian Ocean, abyssal [618A]

L. planifrons Sars, 1895 (Stephensen, 1926, 1931, 1938; Gurjanova, 1951), north boreal Atlantic, sublittoral to bathyal [240 + B]

L. wulgi sp. nov., eastern Tasmania, Australia [782]

L. zomerysis sp. nov., eastern Bass Strait, Australia, bathyal [782]

L. species "k", herein [254]

Transferred species.

L. ornitorhynchus Bulycheva, 1952 to *Prolaphystiopsis.*

Distribution. Marine; South China Sea; boreal North Atlantic, 167–900 m; northeast of Geyser Bank near Madagascar, Indian Ocean, 2300–2500 m; and southeastern Australia, 102–1000 m; often on crinoids or corals.

Key to species of *Laphystiopsis*

1.	Pleonite 4 lacking dorsal process	*L. latirostris*
—	Pleonite 4 with dorsal process	2
2.	Epimeron 2, posteroventral corner truncate	*L. zomerysis*
–	Epimeron 2, posteroventral corner rounded	3
3.	Dorsal cusps of pleonites 3–4 pointed	*L. planifrons*
	Dorsal cusps of pleonites 3–4 rounded	4
4.	Rostrum reaching or exceeding second peduncular segment; ventral margin of coxa 4 even, broadly emarginate	*L. iridometrae*
	Rostrum barely reaching end of first peduncular segment; ventral margin of coxa 4 produced midventrally	*L. wulgi*

Laphystiopsis planifrons Sars

Figures 1–3

Laphystiopsis planifrons Sars, 1895: 386, pl. 135. Norman, 1895: 488.—Stebbing, 1906: 209.—Stephensen, 1926: 73; 1928: 185, fig. 36 (6–10); 1929: 106, fig. 25 (156); 1931a: 208; 1938b: 182.—Oldevig, 1933: 113.—Gurjanova, 1951: 495, fig. 323.—Oldevig, 1959: 48.

Material examined. U.S. Fish Commission Lot 547, which in written records (not on label) is: Gloucester Fisheries Expedition, on schooner *Proctor Brothers,* Sable Island Bank off Nova Scotia, 7 Nov 1879, 43°16′N, 60°35′W, 350 fm (written records cite as 640 m), [?dredge], sample includes sea-anemone, pectens, crinoid *Acanthogorgia pinnata*, and *Alcyonium multiflorum* and *Pennata borealis* USNM 36124 (female "p" 8.25 mm).

U.S. Fish Commission Steamer *Albatross* stn 2429, off Newfoundland, 42°55′30"N, 50°51′00"W, 471 fm, 23 Jun 1885, gray mud, large beam trawl, bottom temperature 38.7°F USNM 31966 (male "o" 6.43 mm). U.S. Fish Commission *Albatross* stn 2540, northwestern Atlantic Ocean, off Massachusetts, 39°58′20"N, 70°52′00"W, 7 Aug 1885, 144 fm, large beam trawl, green sand, bottom temperature 46.7°F (note in vial reads: "many frags of crinoids were found in bottle from which these specimens were taken C.R.S[hoemaker]") USNM 230425 (young male "m" 5.06 mm).

Diagnosis. Head slightly longer than pereonites 1–3, scarcely bulging laterally (as seen from dorsal view); pleonites 1–4 each with conspicuous dorsal bulge or carina; pleonite 4 not longer than pleonite 3; coxa 5, 50% as long as wide; coxa 6 bilobed and wide anteroposteriorally (80% as wide as coxa 5 and 160% as wide as coxa 7), 60+% as long as wide; epimeron 2 rounded posteroventrally; article 5 of pereopods 3–4, 1.5 times as wide as long; article 2 of pereopod 7 broadly pyriform, articles 3–7 together about 3 times as long as article 2 (from Sars, 1895; articles 5–7 absent on present material).

Description of female "p". See illustrations. Head with apparent glandular tissue in place of eye. Antennae 1 broken apically but probably not longer than antenna 2, flagellum with 13+ articles, callynophore with 6 groups of aesthetascs, proximal to distal = 2rudimentary-2-5-4-3-7, following articles 1–8 aesthetasc formula = 2-3-3-3-0-3-0-2. Antenna 2 ordinary, flagellum 20-articulate. Callynophore articles without ridges besides insertion points for rows of aesthetascs. Accessory flagellum very poorly developed. Ventral surface of article 1 on antenna 1 and medioventral surfaces on articles 3–4 of antenna 2 with sparse ridges, stiff setules, weak scales.

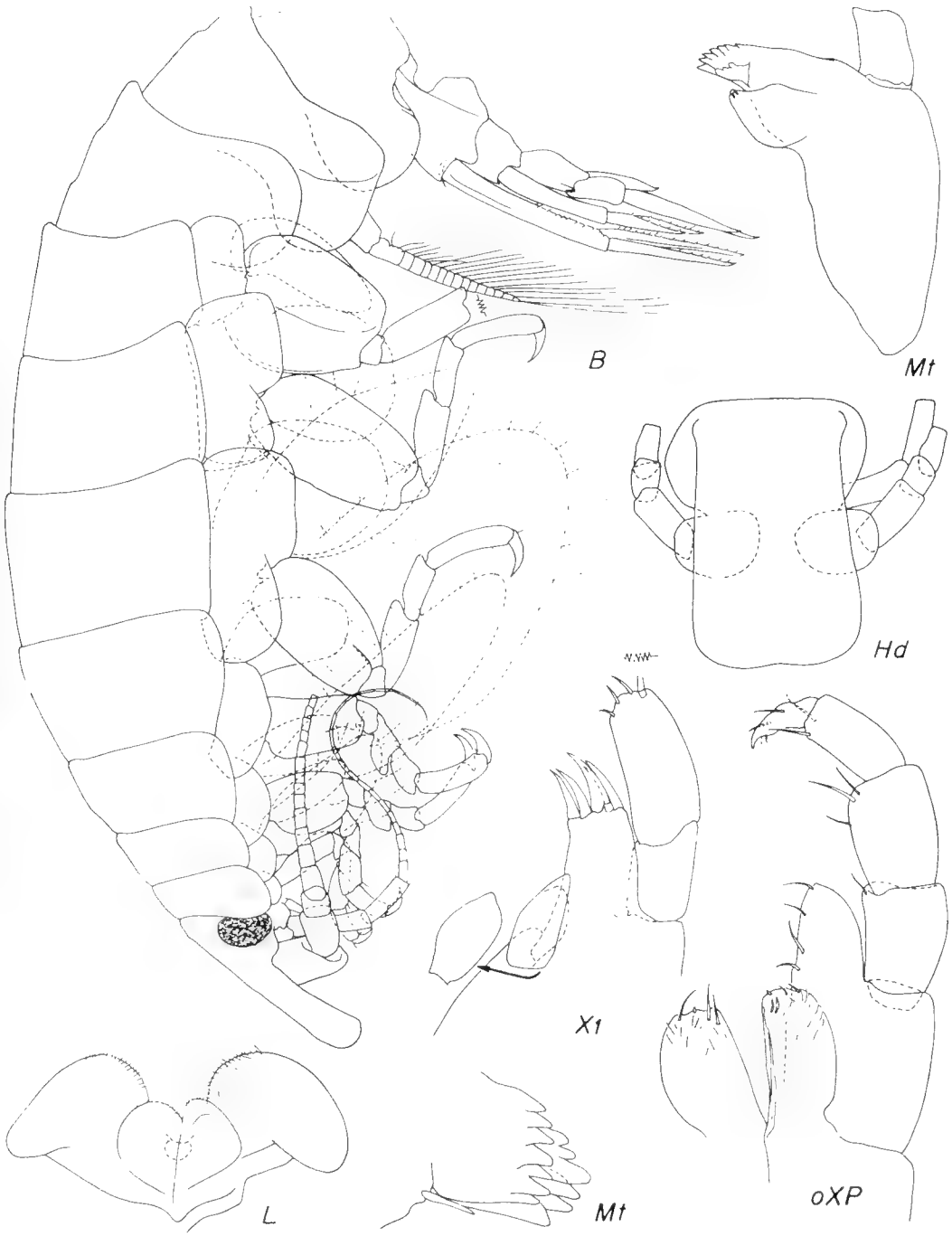

Figure 1. *Laphystiopsis planifrons,* unattributed figures = female "p" 8.25 mm; "o" = male "o" 6.43 mm. Capital letters in figures refer to parts; lower case letters to left of capital letters refer to specimens and to the right refer to adjectives as follows: B, body; C, coxa; D, dactyl; E, epimeron; F, accessory flagellum; G, gnathopod; H, head; L, labium; M, mandible; O, oostegite; P, pereopod; PL, pleopod; R, uropod; T, telson; U, upper lip; V, palp; W, pleon; X, maxilla; Z, gill; d, dorsal; i, inner; m, medial; o, outer; r, right; t, left.

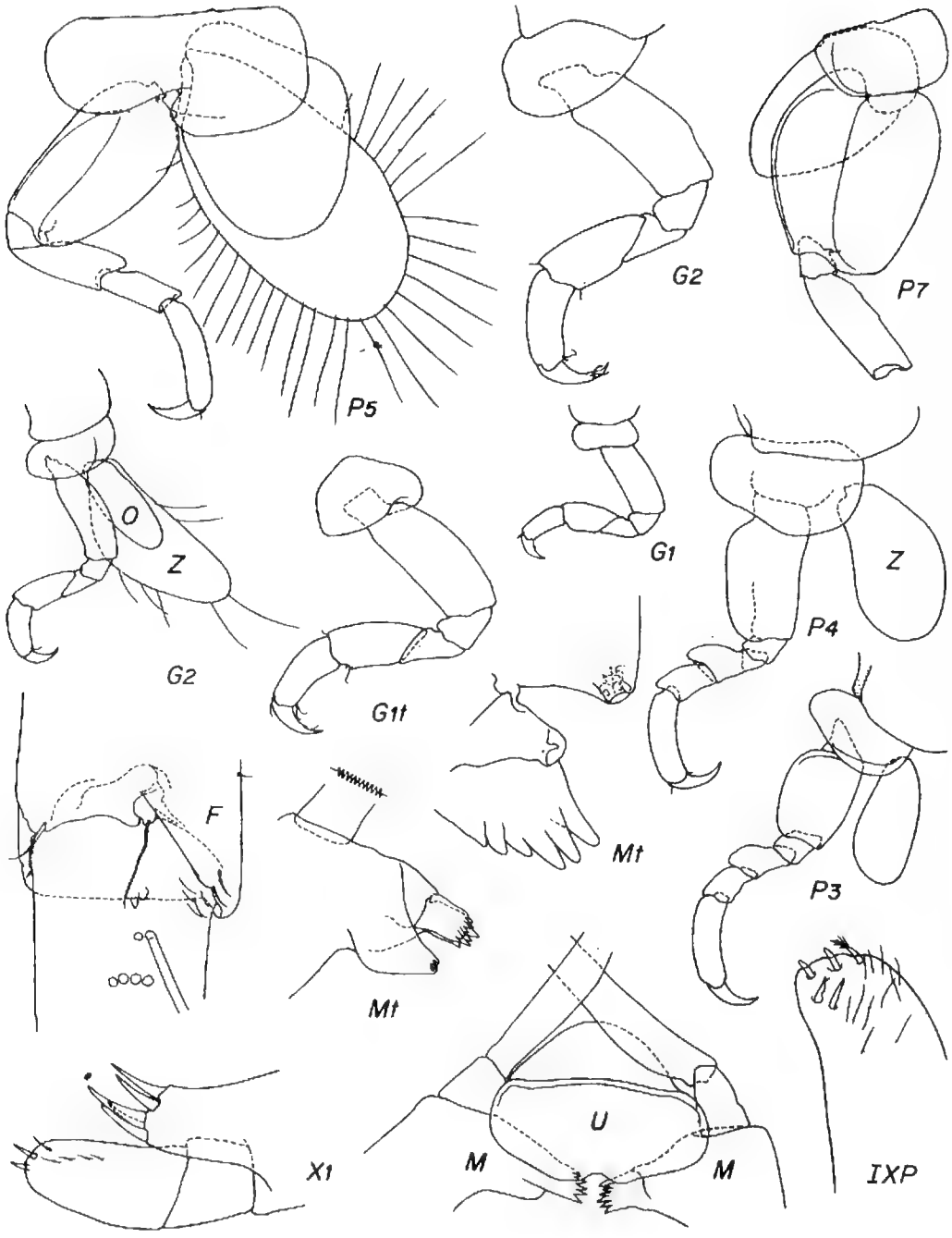

Figure 2. *Laphystiopsis planifrons,* female "p" 8.25 mm.

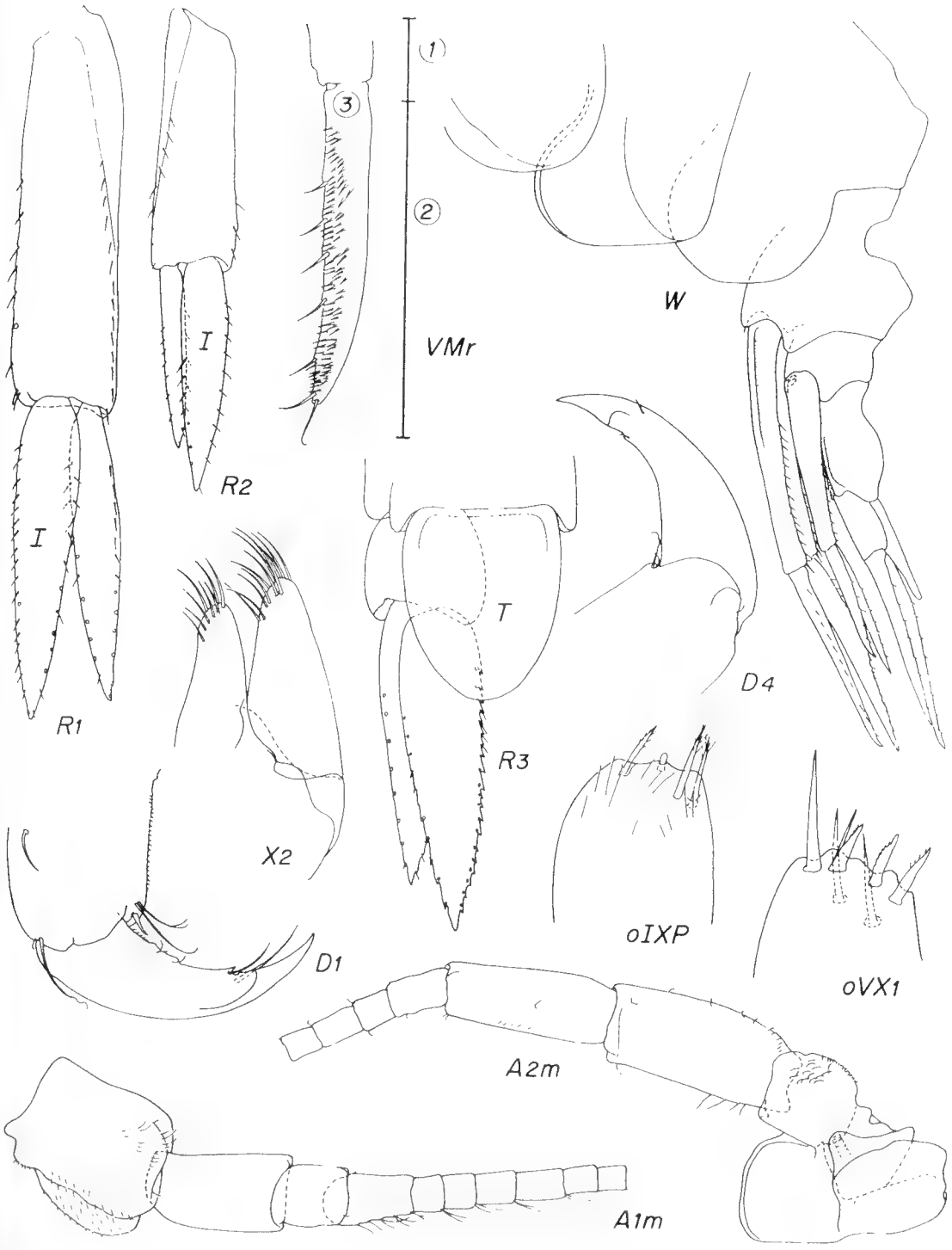

Figure 3. *Laphystiopsis planifrons,* unattributed figures = female "p" 8.25 mm; "o" = male "o" 6.43 mm.

One raker present on left mandible. Right lacinia mobilis very transparent, with 3 teeth, in direct view showing as column. Comb of setae on palp article 3 of complexity shown by Sars (1895). Pleopods 1–2 alike but pleopod 3 smaller, like pleopods of L. *zomerysis*; all inner rami with 12–13 articles, outer with 13. Most spines of uropods 1–2 and setae of uropod 3 missing and marked with pits. Cuticle with saw-tooth ridges and denticles similar to *L. zomerysis* below.

Male "o". Like female but callynophore twice as long, right mandibular palp like female but left with primary marginal setae absent, other scales present.

Illustrations. Pereopod 6 not enlarged, see body; oostegite of pereopod 4 not enlarged, see body; drawing of antenna 2 reduced in relation to antenna 1; apices of maxillae badly eroded; maxillipeds missing (see drawing taken from male "o"; most spines on uropod 3 broken.

Relationship. Because this is the type species of the genus, it will serve as model for comparison of the other species.

Distribution. Northeast Atlantic generally from the Skagerrak northward along Norwegian coast and into Norwegian Sea, 50–900 m; here recorded for first time from northwestern Atlantic Ocean off Massachusetts, Newfoundland and Nova Scotia, 264–861 m.

Laphystiopsis iridometrae Shoemaker

Figures 4–6

Laphystiopsis iridometrae Shoemaker, 1919: 245–246.—Vader, 1978: 126–127 (discussion only).

Material. Holotype, U.S. Fish Commission *Albatross* stn 5310, South China Sea, near Hong Kong, 21°33′N, 116°13′E, 100 fm, 4 Nov 1908, 12 ft tanner beam trawl, sand, shell, bottom temperature 65.5°F, parasitic upon crinoid *Iridometra melpomene* A.H. Clark [= I. *adrestine* A.H. Clark], USNM 49599 (male "g" (newly designated letter) 4.55 mm, with penial processes of regular size).

Other material. *Albatross* stn 5311, South China Sea, near Hong Kong, 21°33′N, 116°15′E, 88 fm, 4 Nov 1908, coarse shell sand, 12 foot tanner beam trawl, mud bag on *Iridometra melpomene*, USNM 49801 (3 subadults and 5 tiny juveniles, including subadults "h" 3.11 mm and "i" 3.15 mm; lacking penes and oostegites). USNM 49600, same data as 49599 (1 subadult and 13 tiny juveniles).

Diagnosis. Head equally as long as percomites 1–3, scarcely bulging laterally (as seen from dorsal view); pleonites 1–4 each with conspicuous dorsal bulge or carina; pleonite 4 not longer than pleonite 3; coxa 5 60% as long as wide; coxa 6 bilobed and wide anteroposteriorally (more than 90% as wide as coxa 5 and 135% as wide as coxa 7), 70+% as long as wide; epimeron 2 rounded posteroventrally, corner rounded; article 5 of pereopods 3–4 1.2 times as wide as long; article 2 of pereopod 7 broadly ovate, articles 2–7 together about equally as long as article 2.

Description of holotype male "g" 4.55 mm. See illustrations. Head with apparent glandular tissue in place of eye. Left antenna 1 broken apically but right one not longer than antenna 2, flagellum with 15 articles, callynophore with 3 groups of 3 setae each, following articles 2–8 aesthetasc formula = 2-3, 2, 1-2, 0, ?, 0, 1-?2 (damaged). Antenna 2 rather short and stunted on left side, but normal on right (see body illustration, with left antenna 2 replaced by right), flagellum 15-articulate. Callynophore article without ridges besides insertion points for rows of aesthetascs. Accessory flagellum very poorly developed. Ventral surface of article 1 on antenna 1 and medioventral surfaces on articles 3–4 of antenna 2 with sparse ridges, stiff setules, weak scales. Maxilliped, inner plate with 2 short marginal setae (1 stout) and 1 stout + 2 thin apical setae, outer plate with 3 marginal setae. One possible raker present on left mandible. Right lacinia mobilis very transparent, with 4 teeth. Comb of setae on article 3 of palp much less complex than shown by Sars (1895) for *Laphystiopsis planifrons* and *L. zomerysis* to follow. Pleopods 1–2 alike but pleopod 3 smaller, drawing of pleopod 1 like pleopod 2, lengths of peduncle and rami of uropod 3 shown; however, all inner rami with 10 articles, outer with 11. Most spines of uropods 1–2 and setae of uropod 3 missing and marked with pits. Cuticle with saw-tooth ridges and denticles similar to *L. zomerysis* below.

Illustrations. Palp of mandible reduced in relation to body of mandible.

Relationship. See *L. wulgi* for differences. Differing from other members of the genus in the very short set of articles 3–7 on pereopods 5–7.

Distribution. South China Sea near Hong Kong, on crinoids; 161–183 m.

Laphystiopsis zomerysis sp. nov.

Figures 7–9

Material examined. Holotype. Australia, Victoria, S of Point Hicks, 38°21.90′S, 149°20.00′ E, 1000 m, 23 Jul 1986, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin* (SLOPE stn 32), NMV J18521 (female "f" 4.60 mm).

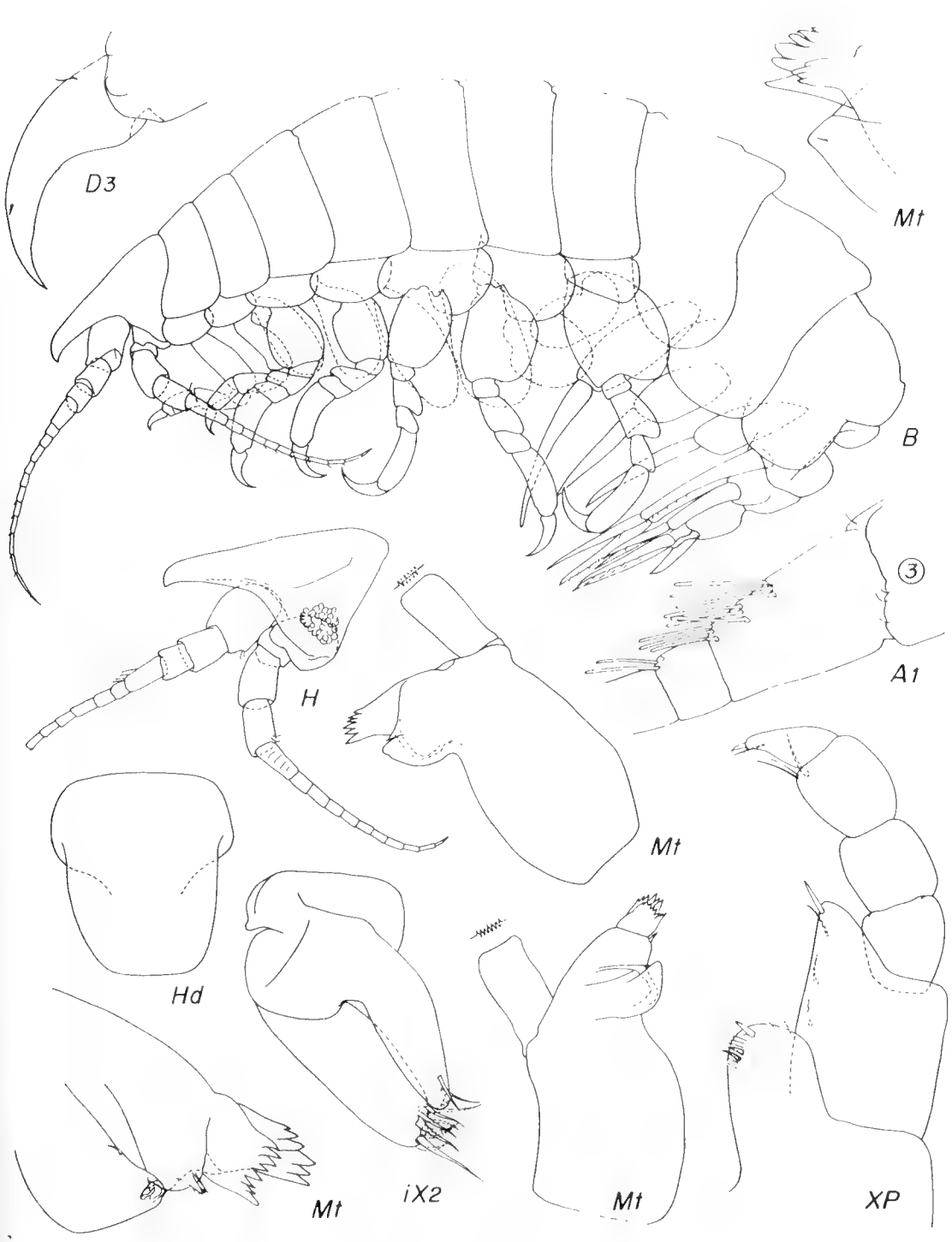

Figure 4. *Laphystiopsis iridometrae,* unattributed figures = holotype male "g" 4.55 mm; "i" = subadult "i" 3.15 mm.

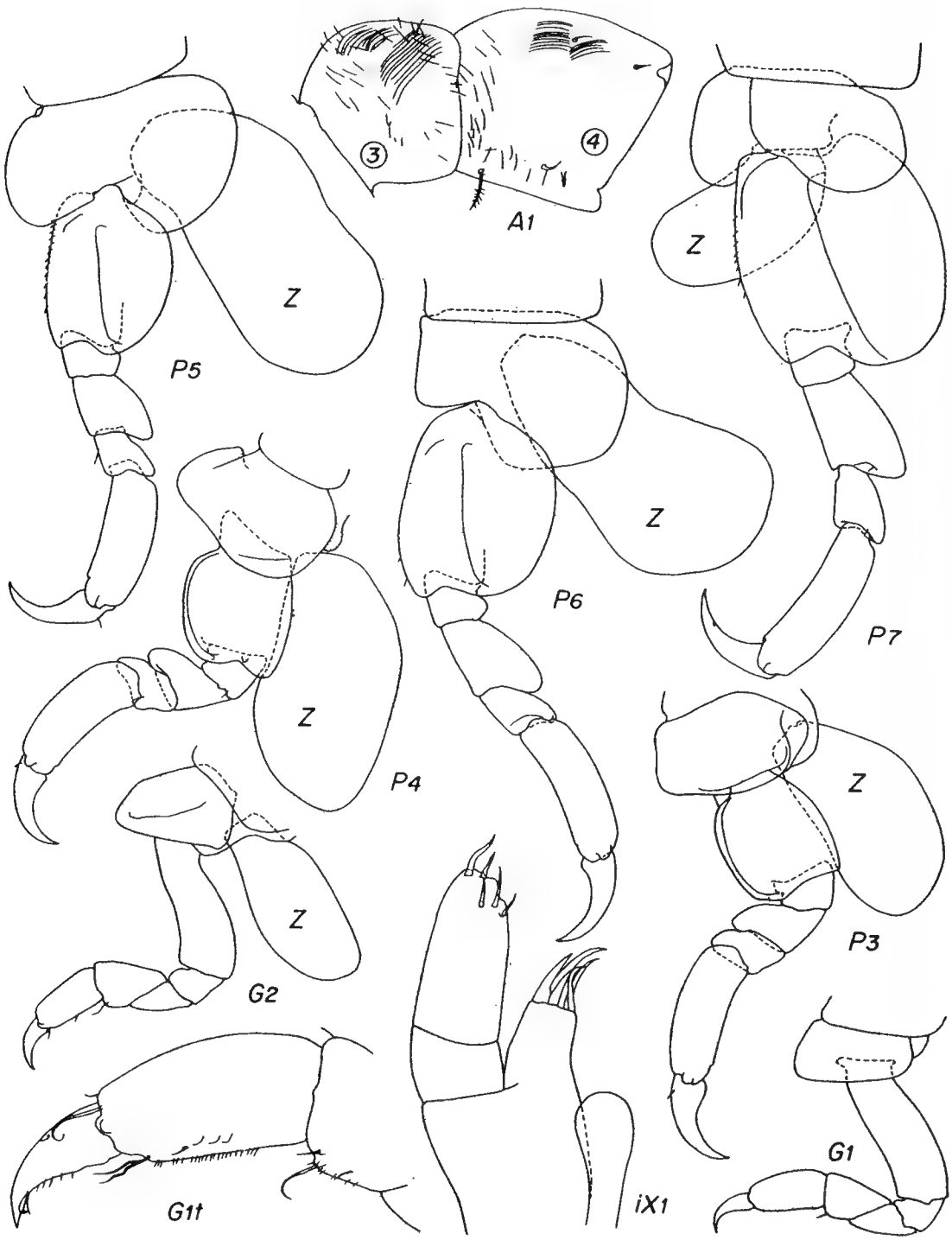

Figure 5. *Laphystiopsis iridometrae,* unattributed figures = holotype male "g" 4.55 mm; "i" = subadult "i" 3.15 mm.

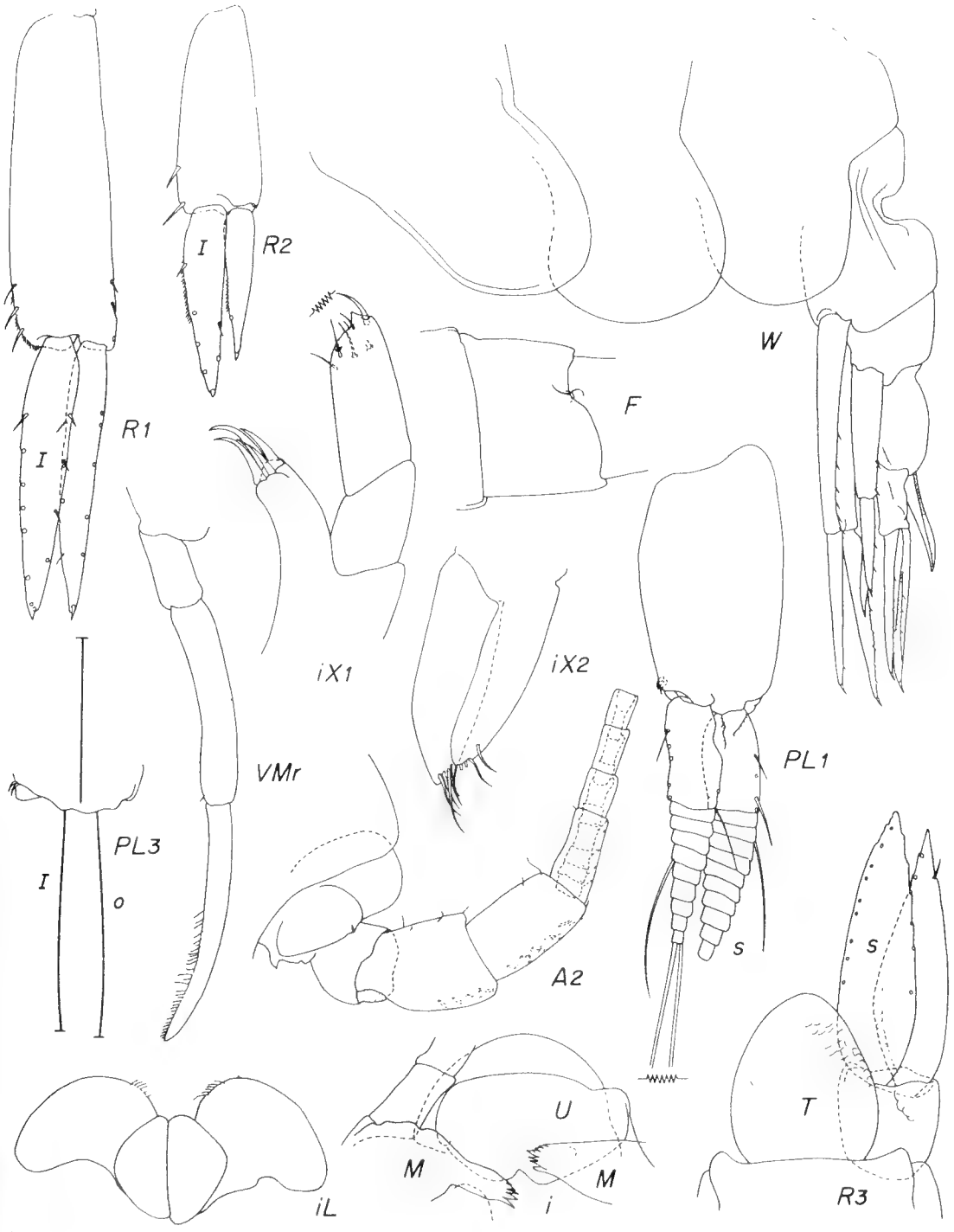

Figure 6. *Laphystiopsis iridometrae,* unattributed figures = holotype male "g" 4.55 mm; "i" = subadult "i" 3.15 mm.

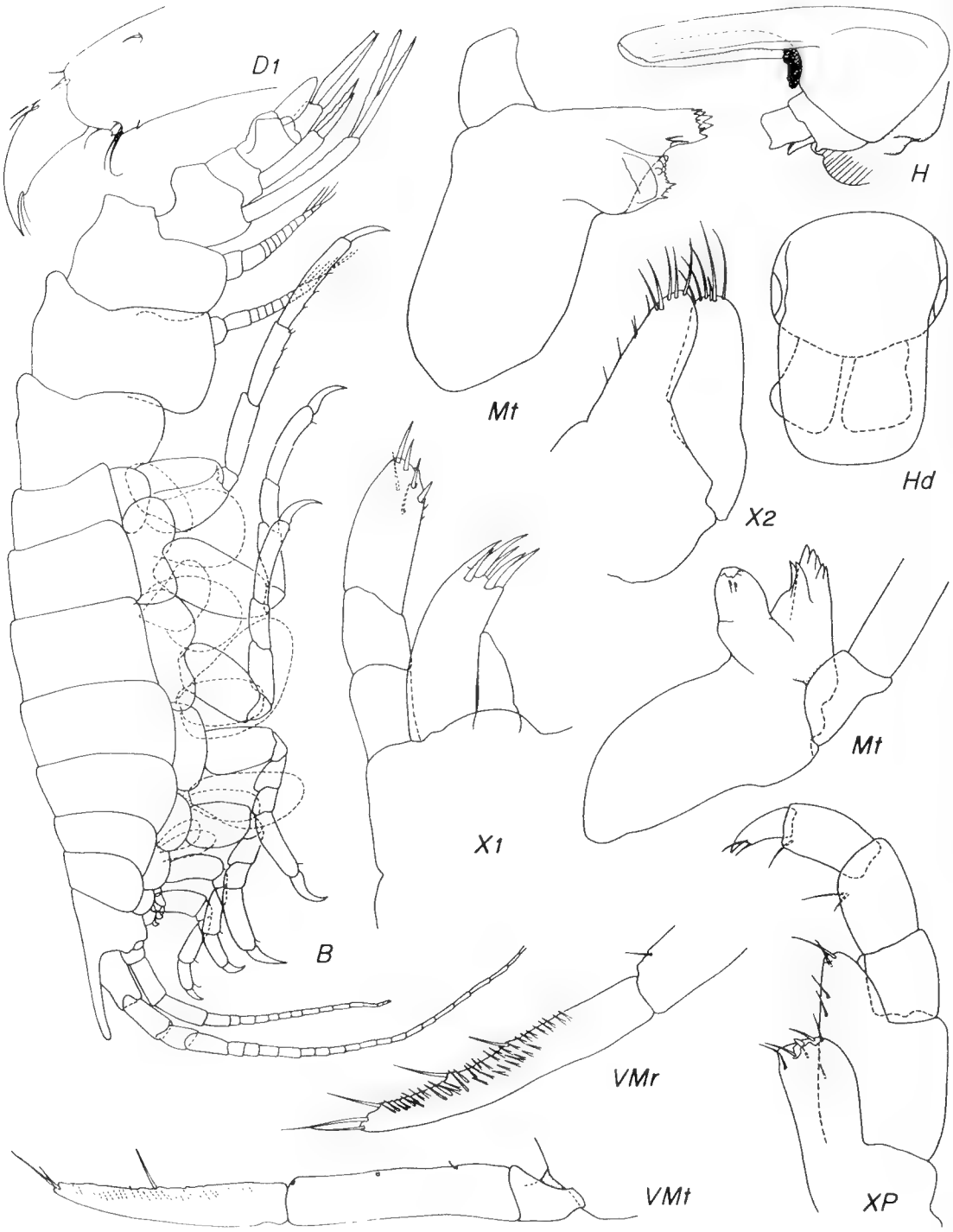

Figure 7. *Laphystiopsis zomerysis,* holotype female "f" 4.60 mm.

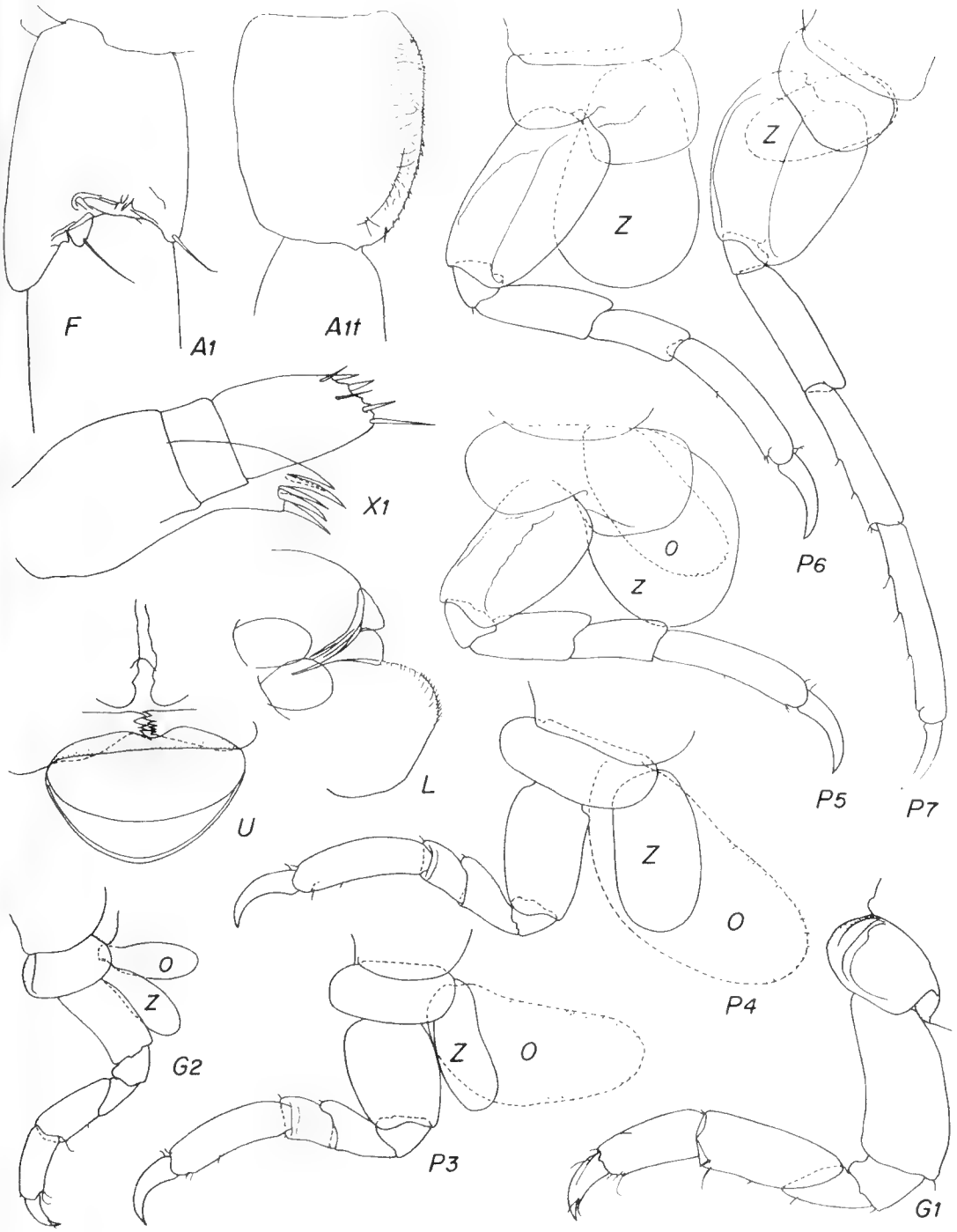

Figure 8. *Laphystiopsis zomerysis,* holotype female "f" 4.60 mm.

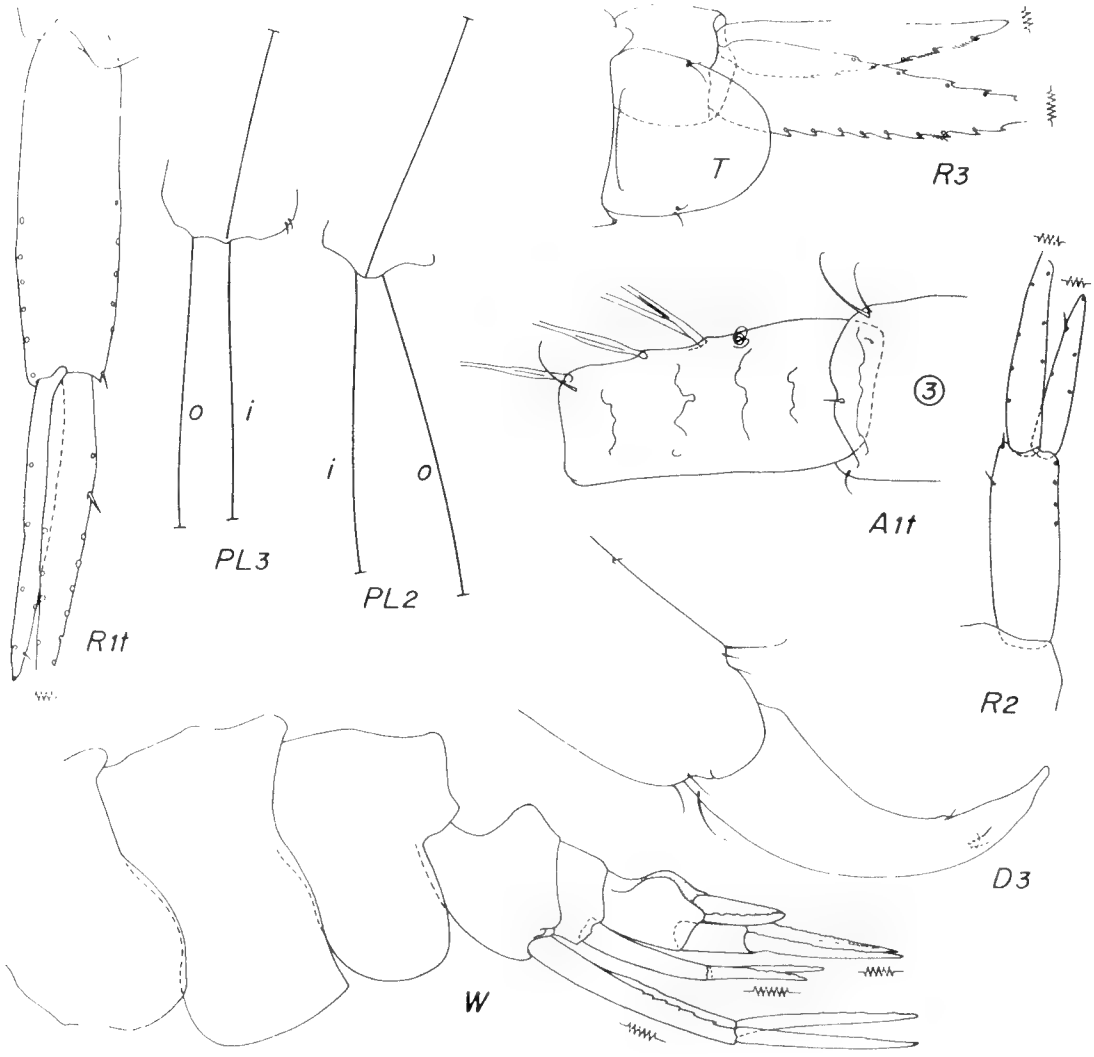

Figure 9. *Laphystiopsis zomerysis,* holotype female "f" 4.60 mm. Stick figures of pleopods show lengths of parts.

Diagnosis. Head about 1.25 times as long as pereonites 1–3 together, scarcely bulging laterally (as seen from dorsal view); pleonites 1–4 each with conspicuous dorsal bulge or carina; pleonite 4 not longer than pleonite 3. Coxa 5 about half as long as wide. Coxa 6 bilobed and wide anteroposteriorally (more than 80 % as wide as coxa 5 and 170% as wide as coxa 7), about 60% as long as wide. Article 5 of pereopods 3–4 about 1.3 times as long as wide. Article 2 of pereopod 7 narrowly pyriform, articles 2–7 together about 3.25 times as long as article 2. Epimeron 2 not beveled, almost quadrate, Posteroventral corner quadrate.

Description. See illustrations. Individual very close to ecdysis, with duplicated parts easily seen inside appendages. Wholemount view with urosomite 3 slightly tilted towards observer to show telson. Setae of oostegites rudimentary. Ventral surface of article 1 on antenna 1 and article 3 on antenna 2 with dense, minute, sharp and ragged ridges and projecting scales and short stiff embedded setules, forming a surface resembling velcro. Left accessory flagellum illustrated, right with 2 setae. Inner (or ventral) surface of callynophore with 4 crosswise sharp meandering ridges, similar ridges present on next 7 flagellar articles, ridge numbers on articles 2–8 as follows: 1-2-2-2-1-1-1, vestigial ridge on article 9; callynophore also with 3 sets of 1–2 aesthetases, next instar apparently to develop many more multiple sets. Antenna 1 broken apically, thus relationship to length of antenna 2 unknown. Right mandible only with deeply bifid lacinia mobilis, no raker spines; left lacinia mobilis broadly toothed like incisor, not distinctly separated from mandibular body (not a next-instar duplicate of incisor because that complex observable deep within body of mandible), therefore 2 spines proximal to incisor called rakers. Outer plate of maxilla 1 with 6 spines, the sixth smallest and thinnest overlapping face of fourth spine from medial margin; inner plate lacking seta. Pleopods: see stick-figures of lengths, pleopods 1–2 alike, pleopod 3 much shorter, outer rami with 11 articles, inner with 10, coupling hooks 2, peduncles not setose. All setae of uropod 3 broken off, their insertions marked as circles at the bases of the hooked serrations on margins of rami.

Illustrations. Drawing of left mandibular palp reduced compared with body of mandible but apex of right palp drawn at same magnification as body of mandible.

Etymology. From Greek, *zomerysis*, meaning "spoon" or "ladle", referring to the rostrum of this animal.

Relationship. The new species differs from *L. latirostris* in dorsal armament and coxae. The outer and inner plates of maxilla 1 of *L. latirostris* were not described. The lower lip of *L. zomerysis* is also poorly known. In *L. latirostris* coxa 6 is only about half as long as coxa 5 and shorter than coxa 7.

There is an uncanny resemblance of *L. zomerysis* to *Laphystiopsis planifrons* in general body aspect but *L. zomerysis* differs from *L. planifrons* in the shorter and less robust rostrum, the stronger dorsal protrusions on pleonites 1–2, a blunter protrusion on pleonite 4, a broader notch on the upper lip, a definite triturative area on the molar, lack of a seta on the inner plate of maxilla 1, and, the squared posteroventral corner of epimeron 2. Differing from *L. iridometrae* in the squared epimeron 2 and the longer set of articles 3–7 on pereopods 5–7.

Distribution. Australia, eastern Bass Strait, 1000 m.

Laphystiopsis wulgi sp. nov.

Figures 10–12

Material. Holotype. Tasman Sea, 15 km E of Maria Island, Tasmania, 42°37′S, 148°20′E, 9 Oct 1984, 102 m, WHOI epibenthic sled, R.S. Wilson (stn S05-84-1), NMV J18530 (female "j" 4.28 mm).

Diagnosis. Head only 80% as long as pereonites 1–3, scarcely bulging laterally (as seen from dorsal view); pleonites 1–4 each with conspicuous dorsal bulge or carina; pleonite 4 not longer than pleonite 3; coxa 4 with midventral projection; coxa 5 60% as long as wide; coxa 6 bilobed and wide anteroposteriorally (more than 80 % as wide as coxa 5 and 200% as wide as coxa 7), 70% as long as wide; epimeron 2 beveled posteroventrally, corner rounded; article 5 of pereopods 3–4 1.1 times wider than long; article 2 of pereopod 7 broadly ovate, articles 2–7 together about 2.2 times as long as article 2.

Description. See illustrations. Setae of oostegites well developed, oostegites huge, oostegite on coxa 2 absent. Ventral surface of article 1 on antenna 1 and article 3 on antenna 2 with dense, minute, sharp and ragged ridges and projecting scales and short stiff embedded setules, forming a roughened surface. Inner (or ventral) surface of callynophore without crosswise sharp meandering ridges, no ridges present on flagellar articles. Callynophore also with 3 sets of 2 aesthetases each, next instar not visible. Flagellum of antenna 1 with 19 articles, of antenna 2 with 17, distal reach of antenna 2 two flagellar articles shorter than antenna 1 when stretched out together. Right

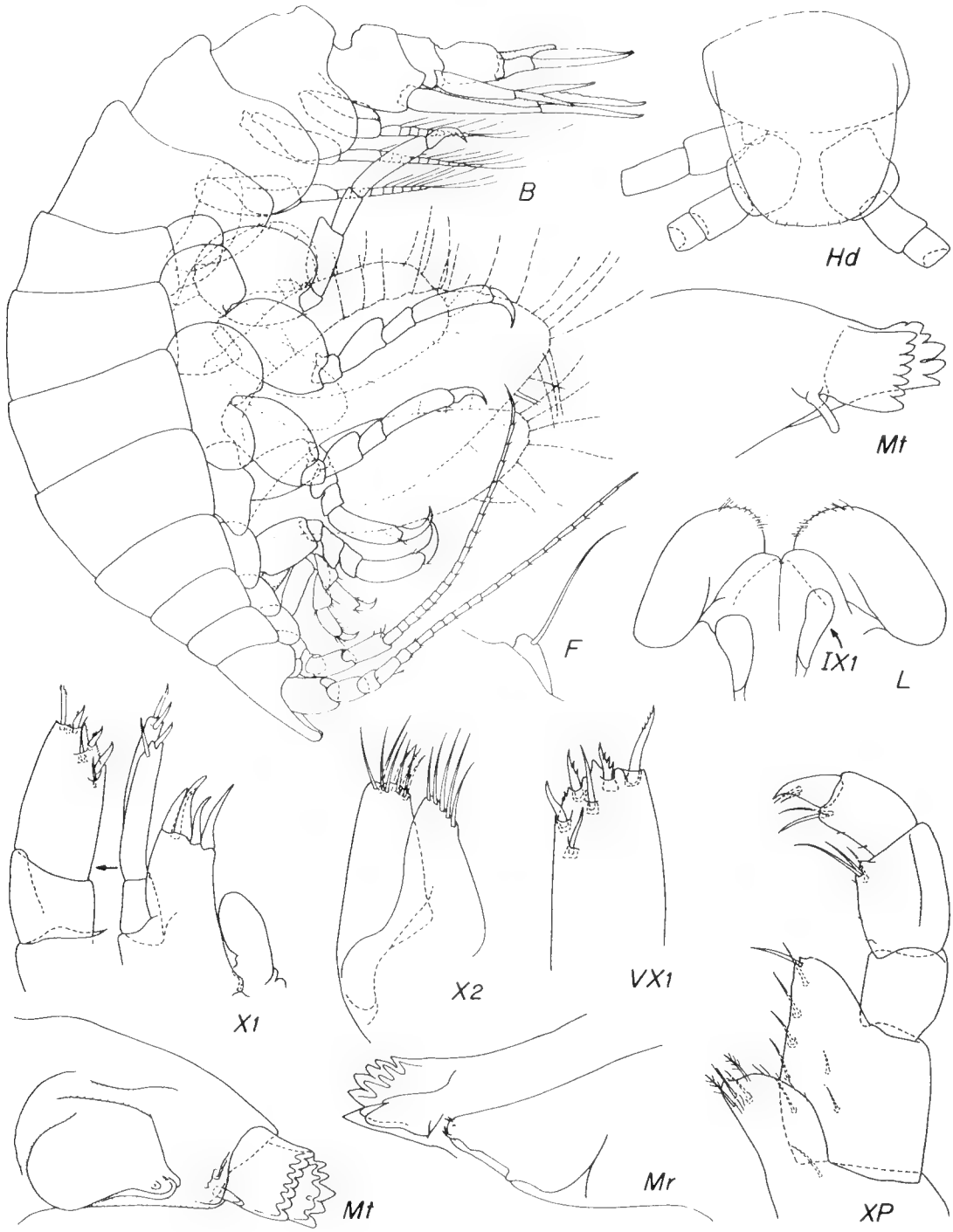

Figure 10. *Laphystiopsis wulgi,* holotype, female "j" 4.28 mm.

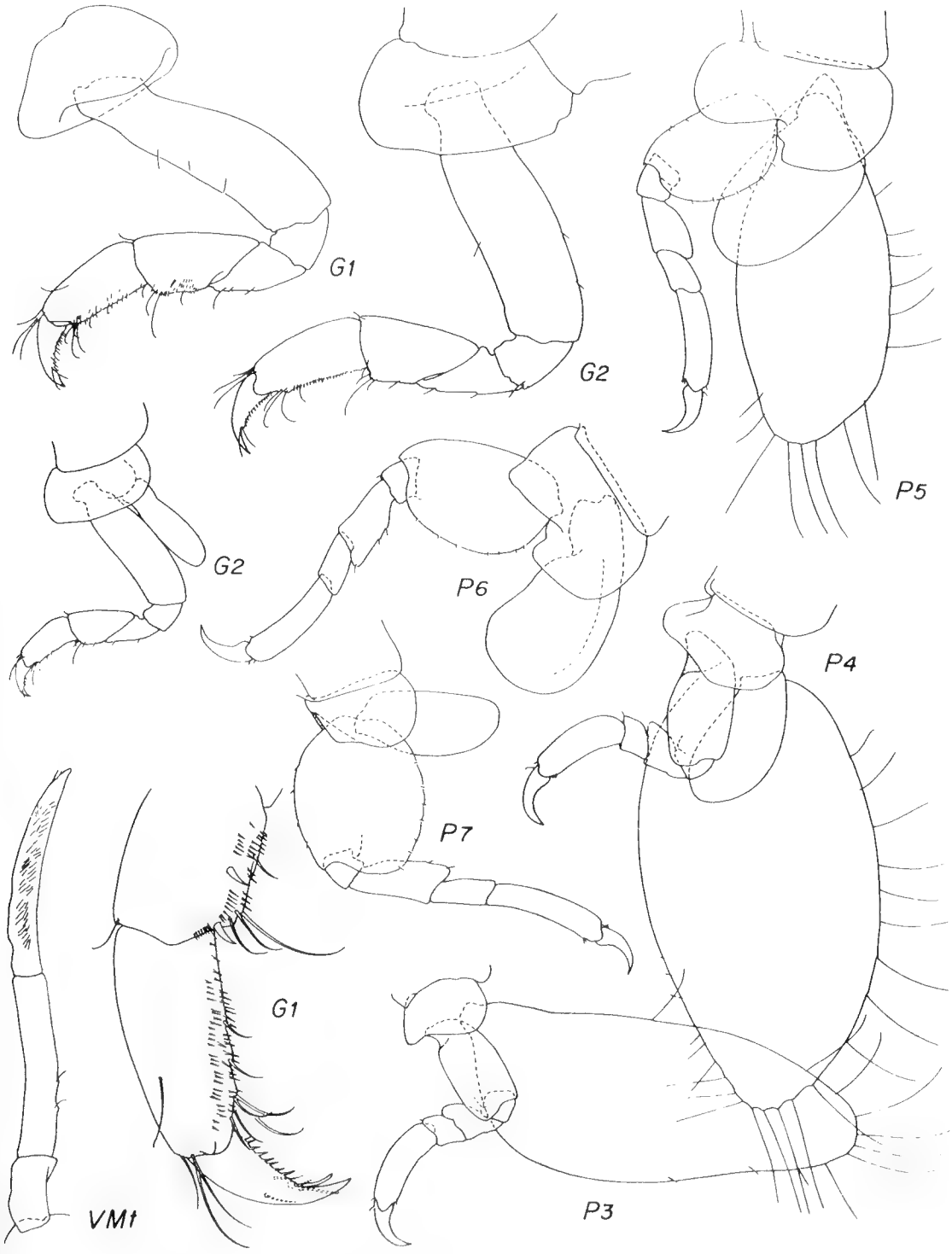

Figure 11. *Laphystiopsis wulgi,* holotype, female "j" 4.28 mm.

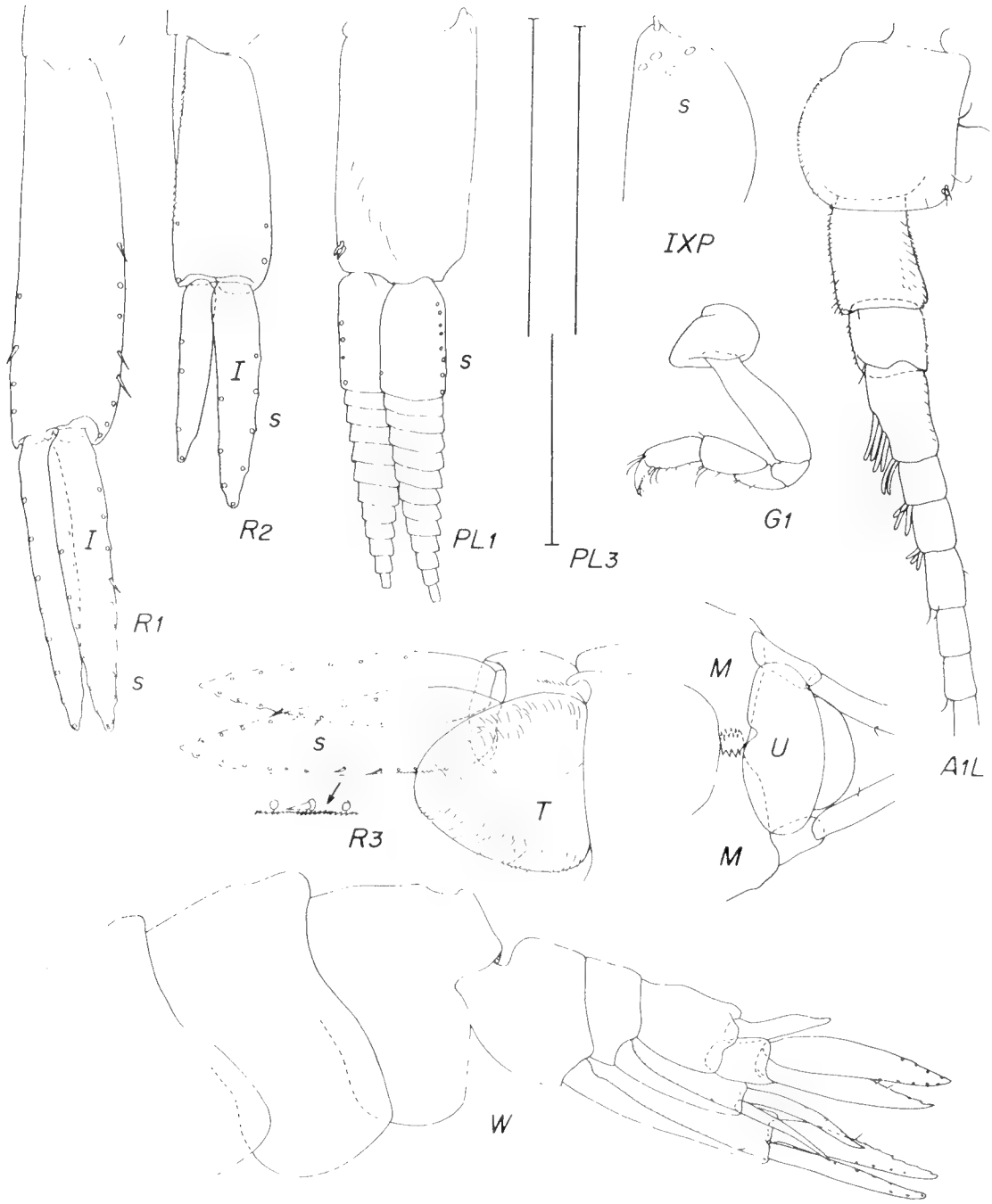

Figure 12. *Laphystiopsis wulgi,* holotype, female "j" 4.28 mm.

mandible only with deeply bifid lacinia mobilis, no raker spines, drawing showing incisor flat and molar only slightly offset unnaturally; left lacinia mobilis broadly toothed like incisor, not distinctly separated from mandibular body, therefore 1 spine proximal to incisor called raker. Outer plate of maxilla 1 with 5 spines, the fifth smallest and thinnest overlapping face of third spine from medial margin; inner plate lacking seta. Pleopods 1–2 alike but pleopod 3 smaller, drawing of pleopod 1 like pleopod 2, lengths of peduncle and rami of uropod 3 shown as stick-drawing; however, inner rami of pleopods 1–2 with 12 articles, outer with 13 and 14 respectively; pleopod 3 inner ramus with 11, outer with 13 articles. Margins of rami on uropods densely and minutely serrate (see offset enlargement on uropod 2). Most spines of uropod 3 broken off, their insertions marked as circles at the bases of the hooked serrations on margins of rami. Telson covered apically and laterally with cuticular ridges.

Illustrations. Wholemount view with urosomite 3 slightly tilted towards observer to show telson. Left accessory flagellum illustrated, right similar. Drawing of left mandibular palp reduced in size compared with body of mandible.

Etymology. Australian Aboriginal, an Aboriginal spirit.

Relationship. Laphystiopsis wulgi differs from *L. latirostris* in the parts of the diagnosis involving dorsal armament and coxa 6. The outer and inner plates of maxilla 1 of *L. latirostris* were not described. The lower lip of *L. zomerysis* is also poorly known. In *L. latirostris* coxa 6 is only about half as long as coxa 5 and shorter than coxa 7.

Laphystiopsis wulgi differs from *L. zomerysis* in the shorter head, wider coxae 5–6, much shorter pereopods 5–7, posteroventrally rounded epimeron 2, and thick articles 4–5 of pereopods 3–4. In addition *L. wulgi*, based on a single specimen, has much larger oostegites, a character of uncertain value because the oostegites of the single specimen of *L. zomerysis* are immature (setae rudimentary). It differs from *L. iridometrae* in the longer combined set of articles 3–7 on pereopods 5–7, and the ventrally produced coxa 4, and the smaller posterior lobe of coxa 6.

Distribution. Australia, off eastern Tasmania; 102 m.

Laphystiopsis species k

Material. U.S. Fish Commission *Fish Hawk* stn 1026, off Marthas Vineyard, Massachusetts, 39°50′30″N, 71°23′W, 182 fm, 8 Sep 1881, green mud and sand, on *Hathrometra tenella* (Retzius) (also a label "on *Antedon dentata* (Say)"), USNM 38155 (specimen "k").

Notes. Specimen in poor condition with shriveled antenna 1, legs 1–4, some broken posterior pereopods; pleonite 4 with giant hood, pleonite 3 scarcely produced dorsally, coxae 5–7, head, urosomal appendages, pleonites 1–2 and pereonite 7 like *L. planifrons*; coxae 1–4 tiny, 3–4 with gaps in front and behind, 1–2 very short but overlapping. Clearly a new species whose formal description is reserved for better material.

Prolaphystiopsis Schellenberg

Prolaphystiopsis Schellenberg, 1931: 115.

Type species. Prolaphystiopsis platyceras Schellenberg, 1931 (monotypy).

Diagnosis. Rostrum well developed but much narrower from dorsal view than in *Laphystiopsis*, sides of head thus bulging laterally on each side almost as much as width of rostrum. Article 1 of antenna 1 formed into huge lobe. Mandibular molar conical, weakly ridged. Inner lobes of lower lip present. Palp of maxilla 1 biarticulate, outer plate with 6–7 spines. Coxae short, broad, anterior coxae ovate, barely touching or weakly disjunct serially, coxa 4 much wider than long, not excavate posteriorly. Pereopods 3–4 alike, with carpus very short. Pleonite 3 very weakly carinate dorsally, but not forming horizontal shelf, urosomite 1 carinate and saddled. Telson short, oval.

Description. Coxae produced forward or not. Articles 2–7 of pereopod 3 like pereopod 4.

Relationship. Differing from *Laphystiopsis* in the narrower rostrum, laterally bulging head and huge lobe on article 1 of antenna 1.

Included species.

P. ornitorhynchus (Bulycheva, 1952) Sea of Japan, 167–510 m [391 + B] comb. nov.

P. platyceras Schellenberg, 1931, Falkland Is, 197 m [831]

Distribution. Sea of Japan, and Falkland Islands, 167–510 m.

Prolaphystiopsis platyceras Schellenberg

Figures 13–15

Prolaphystiopsis platyceras Schellenberg, 1931: 115, fig. 62.

Material examined. "Svenska Südpolar exp. 1901–03 No 58 11/9 1902, 179 m, Bodentemp. 4.1°, Sand und Kies, 52°29′S, 60°36′W, S von W Falkland, Typen,

Typsaml. 712", Swedish State Museum 6622, (8 syntypes). **Lectotype** selected herein: female "a" 7.64 mm. Paralectotypes: "b" female 4.3 mm, "c" broken, sex not determined 3.2 mm, "d" in 2 pieces ?sex, 2.0 mm, "e" juvenile 1.55 mm, "x" female 5.6 mm, "y" female 6.2 mm, "z" 4.6 mm female; sex of certain specimens not determined to avoid further breakage, probably no males present; lectotype measured to nearest 0.01 mm, others to nearest 0.1 mm.

Diagnosis. (In same context as *Laphystiopsis* spp.) Head scarcely longer than pereonites 1–2, strongly bulging laterally (as seen from dorsal view); pleonites 2–3 each with indistinct dorsal bulge or carina; pleonite 4 shorter than pleonite 3; coxa 5 45% as long as wide; coxa 6 bilobed and not very wide anteroposteriorally (66% as wide as coxa 5 and 162% as wide as coxa 7), 45% as long as wide; epimeron 2 rounded posteroventrally, corner rounded; article 5 of pereopods 3–4, 0.9 times as wide as long; article 2 of pereopod 7 narrowly pyriform, articles 2–7 together [unknown, broken].

Description of lectotype female "a" 7.64 mm. See illustrations. Head with apparent glandular tissue in place of eye. Antenna 1 longer than antenna 2, about as long as head plus pereonites 1–4 together, flagellum with 22 articles, callynophore with 4 groups of 3 4 aesthetascs each (not all shown in figure), following articles 2–9 aesthetasc formula = 4-3-2-2-1-1-1-0. Antenna 2 short, about 60% as long as antenna 2, flagellum with 14 articles. Callynophore article without ridges besides insertion points for rows of aesthetascs. Accessory flagellum very poorly developed. Ventral surface of article 1 on antenna 1 and medioventral surfaces on articles 1–3 of antenna 2 with sparse ridges, stiff setules, weak scales. One raker present on each mandible. Right lacinia mobilis very transparent, with 2 teeth. Comb of setae on article 3 of palp about as complex as shown by Sars (1895) for *Laphystiopsis planifrons* and *L. zomerysis*. Pleopods 1–2 alike but pleopod 3 slightly smaller, stick drawing of pleopod 1 like pleopod 2, lengths of peduncle and rami of uropod 3 shown, appearance of pleopods like those drawn herein for one or more species of *Laphystiopsis*; however, inner rami of pleopod 1 with 11 articles, outer with 13, inner of pleopods 2–3 with 13, outer with 15; coupling hooks 2 per pleopod, no accessories. Most spines of uropods 1–2 and setae of uropod 3 missing and marked with pits. Cuticle with saw-tooth ridges and denticles similar to *L. zomerysis* above.

Juvenile "e" 1.55 mm. Smallest available; very similar to adult, principal noticeable external difference: coxae 5 and 6 narrower, longer, posterior lobes slightly longer than anterior lobes; appendages much less spinose and setose, for example, outer rami of uropods 1–3 with 4-2-4 spines only; flagellum of antenna 2 with 9 articles, antenna 1 broken.

Illustrations. Uropod 1 enlargement reduced to 75% of uropods 2-3-telson. Two views of lower lip from female "x" are anterior and posterior, one tilted, other flatter; upper and lower lips of lectotype damaged and not analyzed. Drawings of mandibles purporting to show more than raker but other projections apparently are scales or setules.

Distribution. South of West Falkland Islands; 179 m.

Prolaphystiopsis ornitorhynchus (Bulycheva) comb. nov.

Laphystiopsis ornitorhynchus Bulycheva, 1952: 199–201, fig. 4.

Remarks. No body view of this species was given in the original description so many elements of a diagnosis cannot be calculated (sizes of coxae, for example). I presume this species to be distinct from *P. platyceras* but there is not much character information to go on: the long setae on the huge lobe of antenna 1; and slightly different shapes and setation patterns on gnathopods, pereopod 7, mandibular palp and other mouthparts.

Distribution. Petra Velikogo (Peter the Great Bay), Sea of Japan; 167–510 m.

Prolaphystius K.H. Barnard

Prolaphystius K.H. Barnard, 1930: 342.

Type species. Prolaphystius isopodops K.H. Barnard, 1930 (monotypy).

Diagnosis. Rostrum absent, head not bulging. Article 1 of antenna 1 not grossly lobate. Mandibular molar columnar, scarcely triturative, raker spine = 1. Inner lobes of lower lip absent. Palp of maxilla 1 biarticulate. Coxae of ordinary size, touching serially, coxa 4 about as long as wide, excavate posteriorly. Pereopod 3 with elongate carpus. Pleonite 3 dorsally flattened and forming horizontal shelf projecting posteriorly; urosomite 1 unmodified (young) or in adult weakly saddled. Telson elongate, linguiform.

Description. Article 1 of antenna 1 thick, not carinate. Coxae not produced forward. Pereopod 4 distinct from pereopod 3. Pleonites 1–2 not carinate.

Included species.

P. isopodops K.H. Barnard, 1930 [876B]

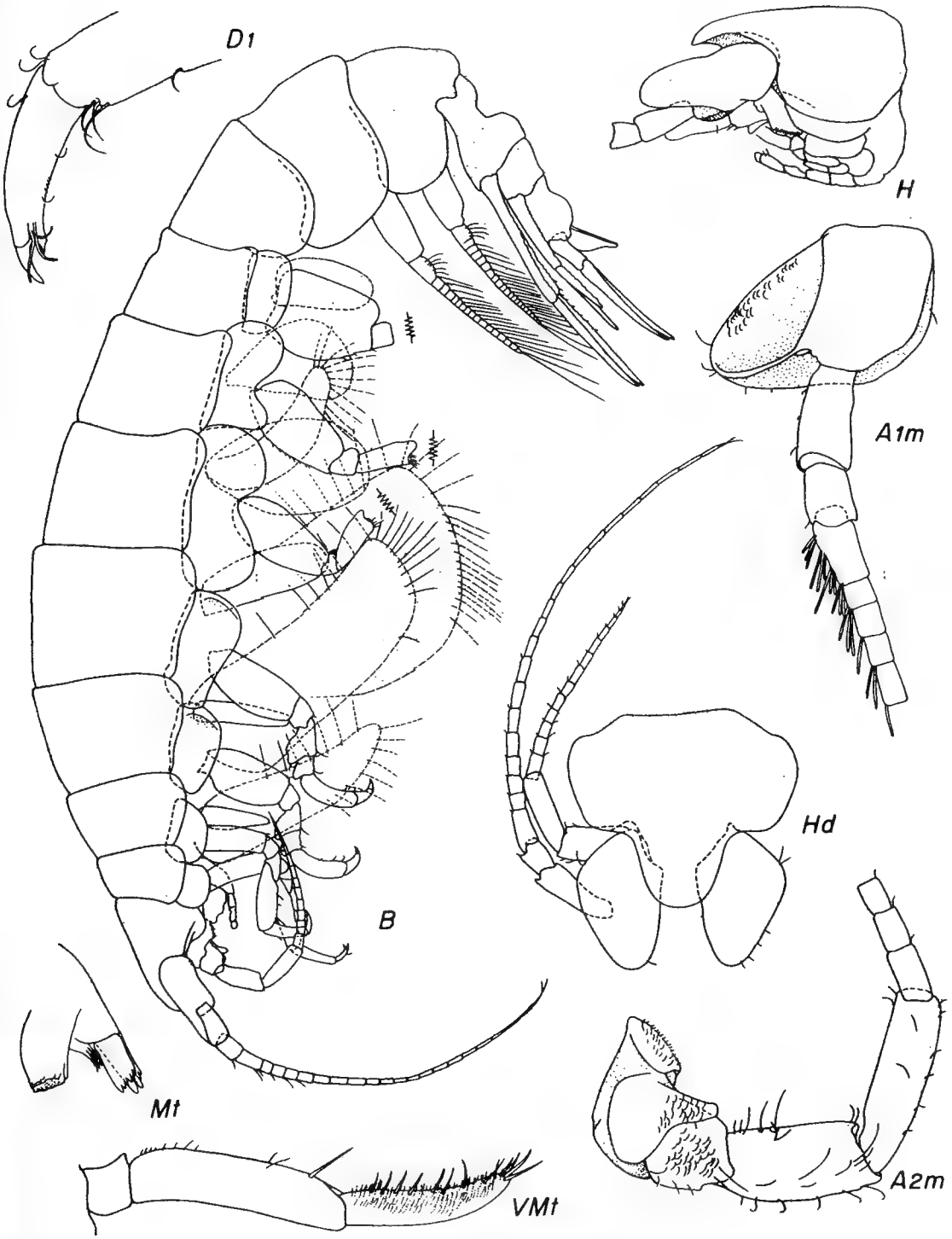

Figure 13. *Prolaphystiopsis platyceras,* lectotype female "a" 7.54 mm.

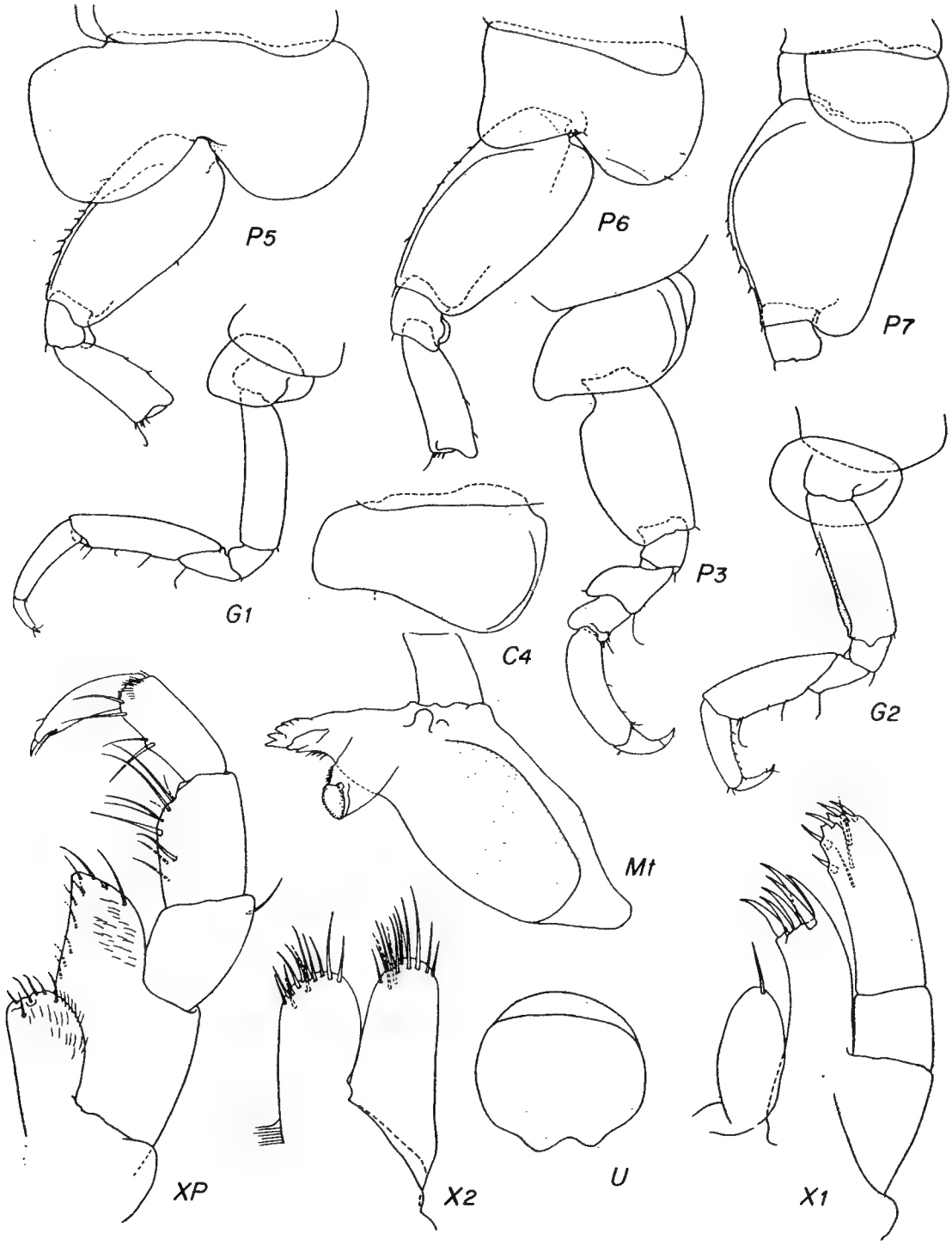

Figure 14. *Prolaphystiopsis platyceras,* unattributed figures = lectotype female "a" 7.54 mm; "x" = female "x" 5.6 mm.

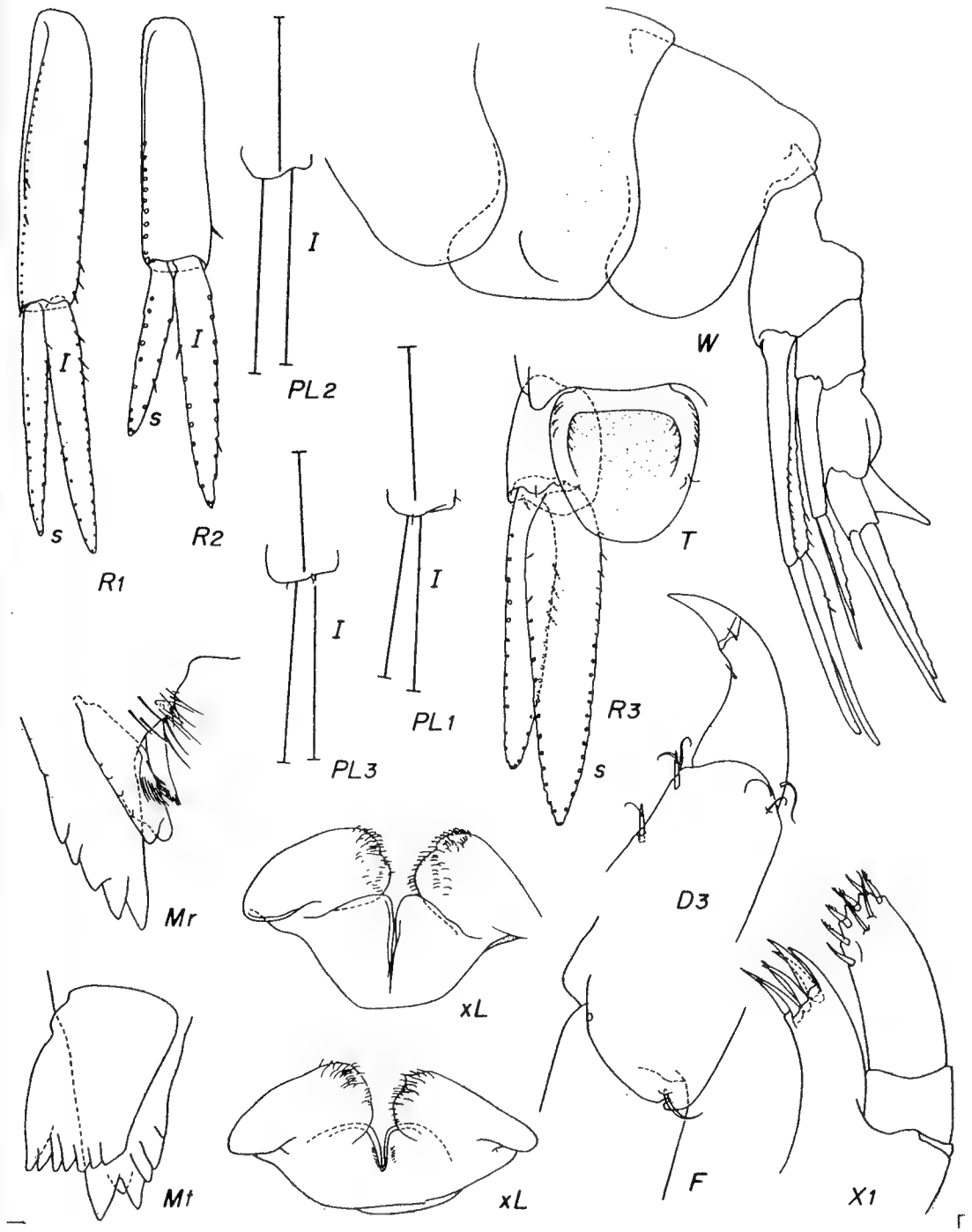

Figure 15. *Prolaphystiopsis platyceras,* unattributed figures = lectotype female "a" 7.54 mm; "x" = female "x" 5.6 mm. Note two views of lower lip.

Distribution. Marine, Antarctica, McMurdo Sound; 406–441 m.

Acknowledgments

Thanks to Dr. F. M. Bayer for information about the names of crinoids. I acknowledge the extensive help given by Drs G.C. B. Poore, Jean Just and Robin Wilson at Museum Victoria. Mrs Elizabeth Harrison-Nelson at Smithsonian Institution assisted me in preparation of this work. Mrs. Linda B. Lutz, of Vickburg, Mississippi, inked the illustrations. Lennart Sandberg of Naturhistoriska Riksmuseet, Stockholm, kindly loaned the syntypes of *Prolaphystiopsis platyceras*.

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Memoirs of Museum Victoria 57(2): 311–317 (1999)

DESCRIPTION OF A NEW SPECIES OF THE PACIFIC SHRIMP GENUS *PARACRANGON* (CRUSTACEA: DECAPODA: CRANGONIDAE) FROM SOUTHERN AUSTRALIA, WITH A KEY TO THE GENUS

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Abstract

Hanamura, Y., Wadley, V. and Taylor, J., 1999. Description of a new species of the Pacific shrimp genus *Paracrangon* (Crustacea: Decapoda: Crangonidae) from southern Australia, with a key to the genus. *Memoirs of Museum Victoria* 57: 311–317.

A sixth species of the genus *Paracrangon, P. australis* sp. nov. (Crustacea: Decapoda: Crangonidae), is reported from a seamount off southern Australia and from Macquarie Island. The Australian species is unique in having four–five teeth on the dorsal median margin of the carapace, which is associated with a distinct reticulate structure on the supraventral part. All species of the genus recorded to date have four or fewer teeth on the dorsal median margin of the carapace. The present record is the first occurrence of the genus in the southwest Pacific and greatly extends its known geographical range. A key for identification of all species is presented with data on geographical and bathymetric ranges.

Introduction

The genus *Paracrangon* is a small group of crangonid shrimps unique in having no second pereopods. It currently contains five species in the Pacific Ocean, from Japan to off Peru, along the North Pacific subarctic waters (Méndez, 1981; Ohé and Takeda, 1986). Among the species, *P. echinata* Dana, 1852 is a trans-North Pacific species, occurring from the west coast of North America to Japan and the Tsushima Strait in the Sea of Japan, with a wide depth distribution from the sublittoral to over 1000 m. The remaining four species exhibit comparatively limited distributions. *Paracrangon abei* Kubo, 1937 and *P. furcata* Kubo, 1937 are endemic to Japan, while *P. areolata* Faxon, 1893 has been recorded in the eastern tropical Pacific from off Mexico to Peru.

In recent cruises (SS01/97, SS01/99) in southern Australia and Macquarie Island of FRV *Southern Surveyor* epibenthic sled surveys produced several shrimps including six specimens of the genus *Paracrangon*. These specimens differ from other species of *Paracrangon* in having four–five dorsal median teeth on the carapace, and undoubtedly belong to an undescribed species.

This paper reports on this sixth species of *Paracrangon* and provides evidence of an important extension of the known geographical range of the genus to the southwestern edge of the Pacific. The specimens are deposited in collections of the Tasmanian Museum and Art Gallery, Hobart (TM) and Museum Victoria, Melbourne (NMV).

Paracrangon australis sp. nov.

Figures 1–3

Material examined. Holotype. Tasmania, approximately 84 km SSE of South East Cape (44°16′S, 147°20′E), 987 m, epibenthic sled, FRV *Southern Surveyor*, 27 Jan 1997 (stn SS 01/97 36), TM G3656 (ovigerous female, 15.0 mm carapace length).

Paratypes. Tasmania, 84 km SSE off South East Cape (44°16.2′S, 147°19.8′E), "J1" seamount, 1300 m, epibenthic sled, T.N. Stranks et al. on FRV *Southern Surveyor*, 27 Jan 1997 (stn SS01/97 37), NMV J41279 (2 ovigerous females, c. 15, 15.7 mm carapace length).

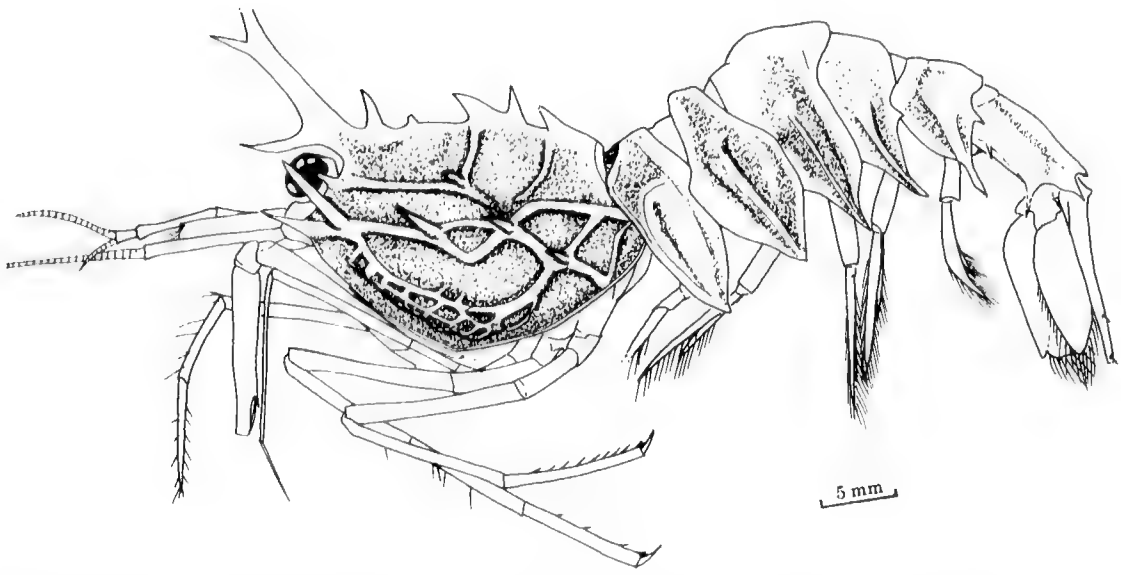

Figure 1. *Paracrangon australis* sp. nov., holotype ovigerous female (cl. 15.0 mm), lateral view.

Other material. Macquarie Island, North end of Gap (52°59.4′ 53°2.0′S, 159°59.0′ 159°58.2′E), 1422 m, Benthic Dredge, FRV *Southern Surveyor*, 31 Jan 1999 (stn SS01/99 130), TM G3756 (1 male 13.5 mm carapace length). Macquarie Island, Beer Garden (53°55.9′ 53°54.9′S, 159°5.9′ 159°2.2′E), 363.6 m, Benthic Dredge, FRV *Southern Surveyor*, 26 Jan 1999 (stn SS01/99 97), TM G4330 (1 male, 12.5 mm carapace length, 1 ovigerous female, 20.0 mm carapace length).

Diagnosis. Rostrum moderately long, directed obliquely upwards, armed ventrally with 2 teeth of normal shape, not furcate. Carapace with dorsal median margin bearing 5 teeth, and supraventral carina forming irregular reticulate structure.

Description of holotype. Rostrum nearly straight (broken off distally), extending obliquely upwards, dorsal margin smooth, without tooth or spine, ventral margin with strong tooth situated just anterior to cornea and slightly smaller tooth placed distally (Fig. 1).

Carapace with dorsal margin carinate for almost entire length, armed with 5 teeth, size varying considerably, first notably larger than second, third tooth robust and fourth tooth subequal to fifth; antennal tooth sharp, reaching midlength of cornea; pterygostomian tooth larger than antennal tooth; branchiostegal tooth set back from anterolateral margin of carapace, strong, flared anterolaterally; distinct carina supporting branchiostegal spine extending backwards to posterolateral margin (lateral carina), widely reticulated posteriorly; 2 teeth decreasing in size posteriorly arising along this carina; carina supporting antennal tooth extending to near midlength of carapace (dorsolateral carina), with small tooth at posterior end; relatively weak carina running between ventral margin and lateral carina (supraventral carina), connecting with lateral carina at both anterior and posterior ends, somewhat reticulate and small tooth present near posterior end; anterior vertical carina running ventrad from base of third dorsal tooth and meeting with dorsolateral carina; posterior vertical carina weak, running ventrad from base of fifth dorsal median tooth, slightly curving anteriorly near ventral end (Figs 1, 2a).

Abdomen with somite 1 rounded or weakly ridged dorsally, but not forming distinct carina; somites 2–5 sharply carinate dorsally, with highest carina on somite 3; somite 6 1.78 times as long as somite 5, 2 median dorsal carinae converging into posterior end, ventrolateral margin with small anterior tooth, and large, developed tooth posteroventrally, posterolateral margin ending in sharp tooth; ventral surface of somite 5 with posteriorly curving sharp, long process near posteromedian part and somite 6 with pair of anteriorly directed sharp processes at anterior end of ventral surface; pleura of somites 1–5 acutely produced ventrally, increasing in size towards posterior, accompanying median pleural carina supporting ventral spine or process, without additional tooth or spine on anterior margin (Figs 1, 2b). Telson broken off distally, but at least 2 pairs of dorsolateral spines present. Exopod of uropod shorter

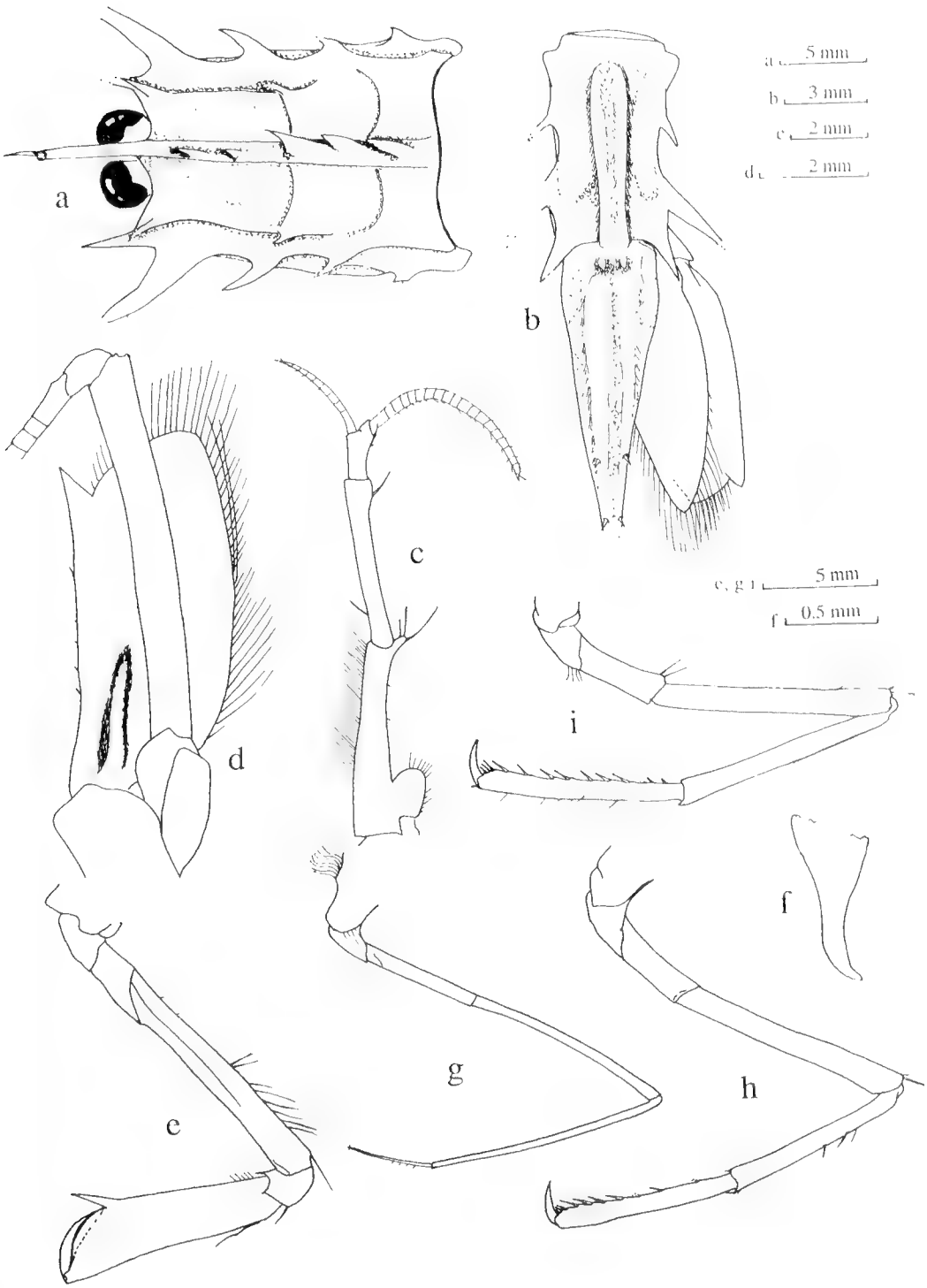

Figure 2. *Paracrangon australis* sp. nov., holotype ovigerous female (cl. 15.0 mm). a, carapace and eye, dorsal view. b, posterior part of body, dorsal view. c, antennule. d, antenna. e, pereopod 1. f, vestigial pereopod 2. g, pereopod 3. h, pereopod 4. i, pereopod 5.

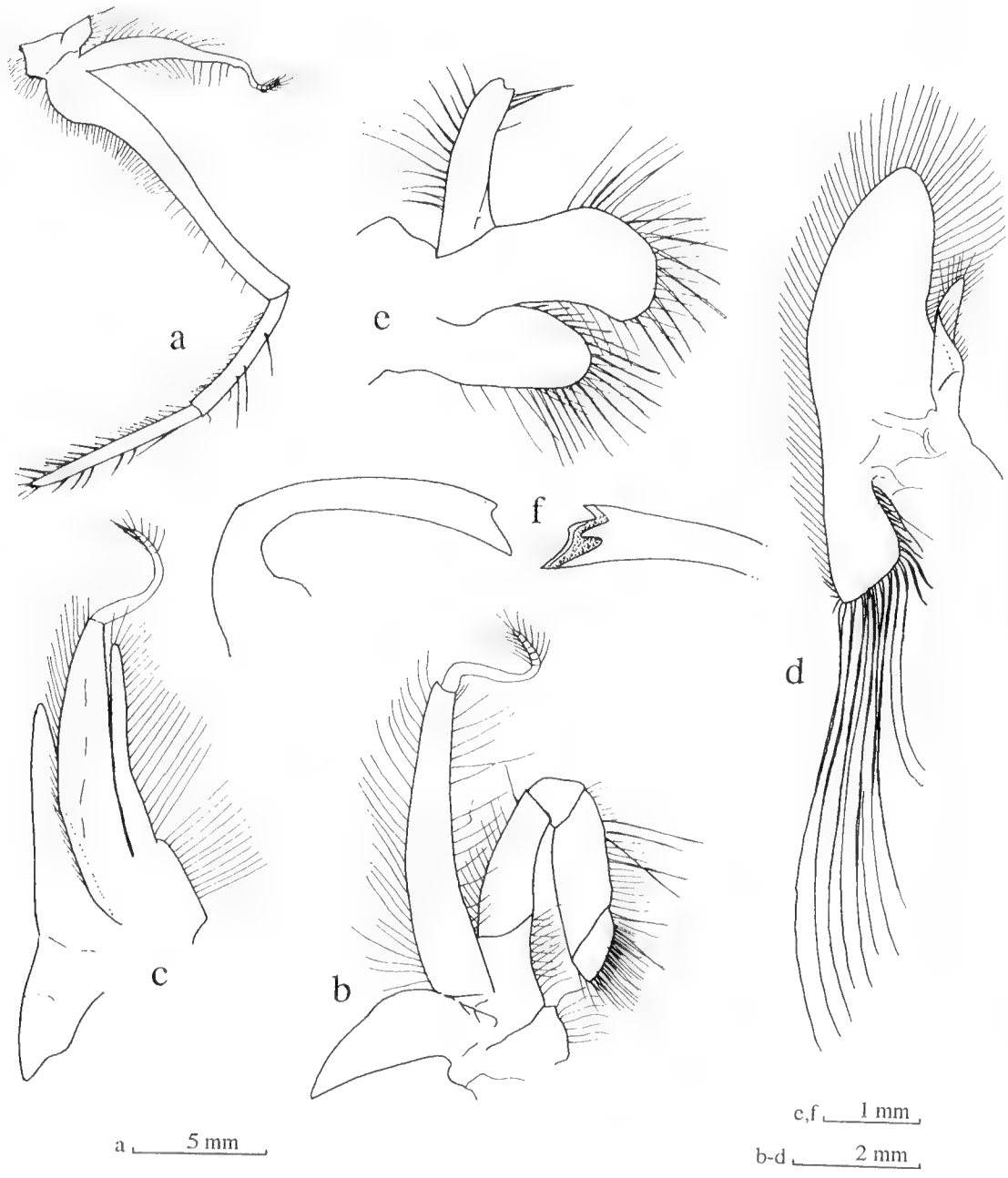

Figure 3. *Paracrangon australis* sp. nov., holotype ovigerous female (cl. 15.0 mm). a, maxilliped 3. b, maxilliped 2. c, maxilliped 1. d, maxilla 2. e, maxilla 1. f, mandible (dorsal view in right figure).

than endopod, with roundly produced distolateral lobe (Fig. 2b).

Eye with cornea well pigmented, slightly wider than eye-stalk (Fig. 2a).

Antennular peduncle relatively slender, with first segment 1.44 times as long as second, latter 2.81 times as long as third; upper flagellum short, composed of 19 articles, flattened towards distally, lower flagellum with 9 articles; stylocerite very short, distally rounded (Fig. 2c).

Antennal scale 0.53 times as long as carapace, 2.42 times as long as wide, distolateral spine falling short of end of lamella; carpocerite long, extending well beyond end of lamella (Fig. 2d).

Mouthparts as illustrated (Fig. 3b–f). Maxilliped 3 extending beyond end of antennular peduncle by length of whole distal segment, latter 1.36 times as long as penultimate (Fig. 3a).

Pereopod 1 subchelate, extending beyond end of antennular peduncle by length of distal third of propodus and dactylus, movable finger sharp, curving inward, fixed finger sharp (Fig. 2e). Pereopod 2 vestigial (Fig. 2f). Pereopod 3 slender, extending as far as end of pereopod 1, dactylus about third length of propodus, with long, sharp terminal seta (Fig. 2g). Pereopod 4 extending beyond end of antennular peduncle by about distal half length of propodus and dactylus; propodus with 8 long ventral spines; dactylus sharp, curving posteriorly, quarter–fifth length of propodus (Fig. 2h). Pereopod 5 extending beyond end of antennular peduncle by about distal third length of propodus and dactylus; propodus with 12–13 ventral spines, including 3 close-set distal spines; dactylus slightly less than fifth length of propodus (Fig. 2i).

Note on paratyes. The paratypes are more or less damaged in the carapace so the number of teeth on the dorsal median margin could not be counted accurately. The dorsal margin of abdominal somite 1 is more weakly ridged in the paratypes than in the holotype but not forming an acute carina as in following somites. Other external features including the carinal structure and ornamentation agree well with those of the holotype.

Colour in fresh condition. The background colour is basically light-red, with a slightly darker red on the rostrum and the posterior part of the abdomen.

Egg size. Non-eyed eggs are nearly spherical, moderately large, diameter 1.8—1.9 mm, and eyed eggs are oval, approximately 2.5 mm along longer axis.

Distribution. The type ovigerous females were collected from 987–1300 m depth approximately 84 km SSE off South East Cape, Tasmania. The more recently discovered material from Macquarie Island was at 363–1422 m. The characteristic red colour suggests this species to be a typical deepwater inhabitant.

Etymology. The specific name "*australis*" (= southern in Latin) indicates that the species is the southernmost inhabitant of the genus.

Remarks. Unlike the five described species of the genus *Paracrangon, P. australis* is unusual in possessing four–five dorsal median teeth on the carapace; all others have four or fewer. An irregularly reticulated structure of the supraventral part of the carapace noted in *P. australis* is similar to that in *P. areolata* and *P. okutanii*. This structure is not found in the remaining three species.

In addition to the carapace spine counts of the dorsal median margin, *P. australis* differs from *P. areolata* in having relatively shorter dactyli of the posterior two pereopods (fifth–sixth length of propodus vs third), and from *P. okutanii* by having proportionately shorter, obtuse ventral projections of the first two pleura, and the rostrum being directed more upward (50° vs 35°).

Although the disposition and number of teeth on the carapace display some intraspecific variations (Brashnikov, 1907; Hayashi, 1986), they have a specific pattern (Table 1). This may simply be due to lack of basic information about this feature partly reflecting the rarity of the species and future study may alter this table. In addition, an exact description of carinal sturucture of the carapace will be useful for definite identification of each species.

A microscopic chitinous lobe between the first and third perepods is considered a second perepod. Confirmation of this is needed in other species.

Discussion

Paracrangon is considered primarily a North Pacific genus with highest species richness in the waters around Japan, four of the five hitherto known species having been recorded there (Fig. 4). Prior to our finding, *Paracrangon areolata* was thought to be the only species to occur in the southern hemisphere.It occurs in the tropical eastern Pacific as far south as 17°S (Méndez, 1981; Hendrickx, 1995). The finding of a sixth species in southern Australian and Subantartic waters is a significant extension to the known geographical

Table 1. Disposition and number of teeth on carapace of species of *Paracrangon*

Species	dorsal median margin	dorsolateral part btween median and lateral carinae	lateral part mainly along lateral carina including branchiostegal and hepatic teeth	ventrolateral part between lateral carina and ventral margin
P. abei	3	2	4	0
P. areolata	4	2	4	0
P. australis	4–5	1	3	1
P. echinata	4	2–6	3–5	2
P. furcata	2–3	0	2	0
P. okutanii	4	1	3	1

range of the genus to 54°S. It is curious that the genus has not so far been found in the tropical western Pacific despite well organized intensive deepwater studies in the region over a hundred years.

Paracrangon is a well established crangonid genus and identification can be made using the following key. The key is modified from those provided by Kubo (1937) and Ohé and Takeda (1986), with a view to providing more conservative characters than the rostrum. The geographical and bathymetric ranges are included.

Key to species of *Paracrangon*

1. Supraventral carina of carapace forming distinct irregular reticulate structure 2
- Supraventral carina of carapace not forming distinct irregular reticulate structure 4
2. Dactyli of posterior 2 pereopods about third length of propodi..... *P. areolata* Faxon, 1893 (eastern tropical Pacific, from off Mexico to Peru; 650–1250 m)
— Dactyli of posterior 2 pereopods about fifth–sixth length of propodi..... 3
3. Rostrum shorter than carapace, obtuse ventral projection of first two pleura equal to or greater than depth of carapace ....*P. australis* sp. nov. (southern Australia, Macquarie Island; 360–1422 m)
– Rostrum longer than carapace; obtuse ventral projection of first two pleura shorter than depth of carapace..... *P. okutanii* Ohé and Takeda, 1986 (Central Pacific coasts of Japan; 425–1205 m)
4. Dorsal median margin of carapace with 4 teeth; all abdominal somites carinated dorsally ..... *P. echinata* Dana, 1852 (California to central Japan and Sea of Japan, throughout North Pacific boreal waters; sublittoral to 1380 m)
— Dorsal median margin of carapace with 2 or 3 teeth; abdominal somite 1 at least, rounded dorsally 5
5. First 2 median dorsal teeth of carapace denticulate distally; dorsal margin of carapace with 2 teeth and basal ventral spine simple, not furcate; abdominal somite 2 carinate dorsally ..... *P. abei* Kubo, 1937 (Japan, central to SW Pacific coasts, along Tushima Current in Sea of Japan; 150–300 m)
— Median dorsal teeth of carapace, simply tapering distally; dorsal margin of rostrum smooth and basal ventral spine furcate; abdominal somite 2 rounded dorsally..... .....*P. furcata* Kubo, 1937 (Japan, central to SW Pacific coasts; 320–400 m)

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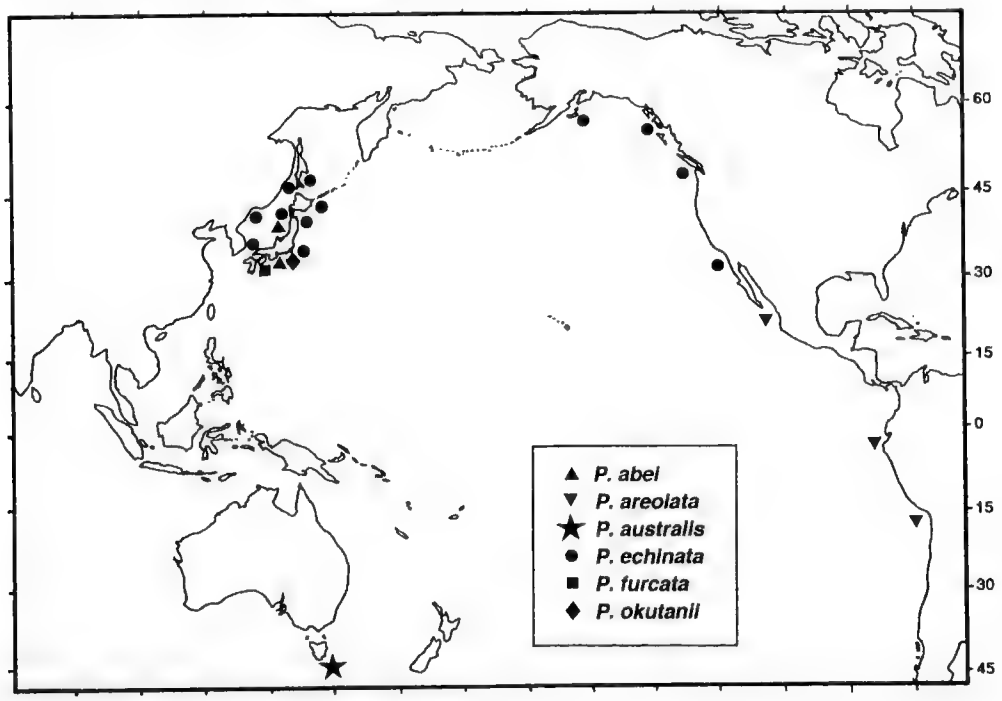

Figure 4. Distribution of species of *Paracrangon*.

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